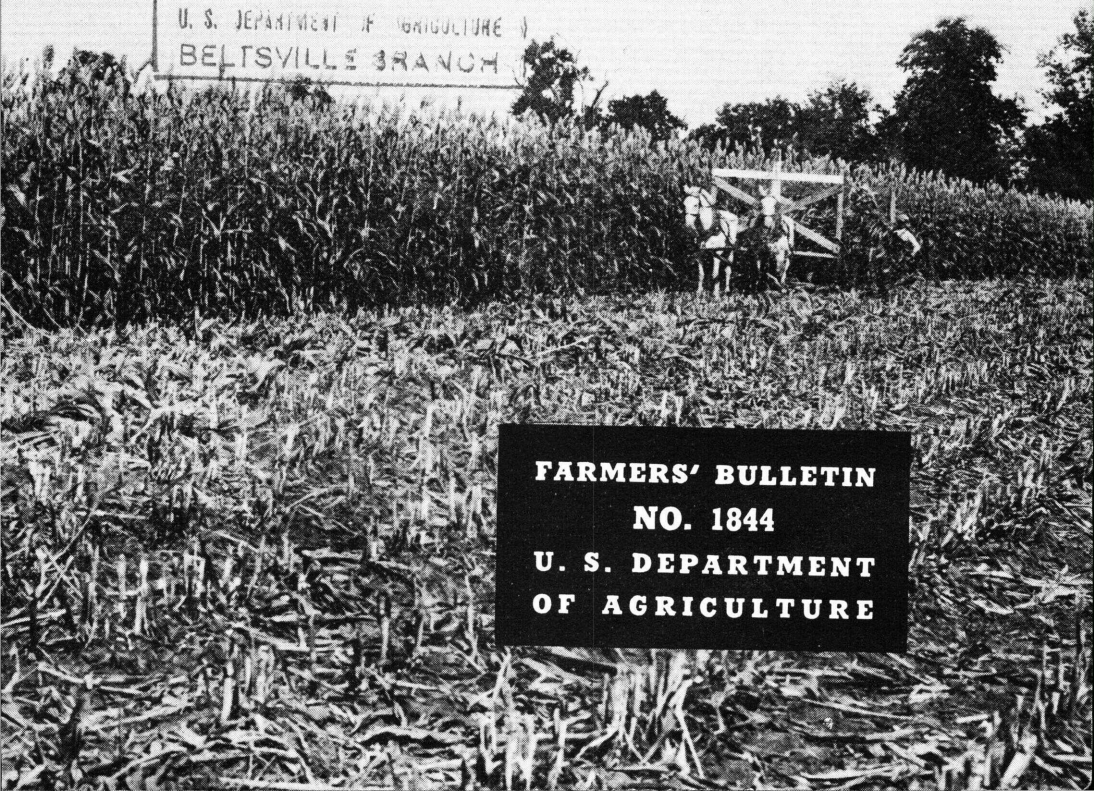
# The Culture and Use of SORGHUMS for Forage





FARMERS' BULLETIN
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OF AGRICULTURE

SORGHUMS are for the most part natives of Africa, and many of the varieties now grown in the United States originated on that continent.

About 10,000,000 acres of sorghum are grown annually in the United States, of which 5,000,000 or more are harvested for forage. Most of this acreage is in the South-Central States.

Its value compared to other forage crops is due to its greater certainty of producing a crop in dry seasons.

The principal varieties of sorgo (sweet sorghum) grown for forage are Sumac, Black Amber, Orange, Honey, Atlas, and Gooseneck. The grain sorghums most valuable for forage are hegari and the Blackhull, Red, Pink, and Dwarf kafirs.

There is little difference in the forage yield of sorghum planted in rows 40 inches apart and that sown in close drills, but the cultivated rows are most dependable in seasons and areas of low rainfall.

Sorghum varieties hybridize freely, and lack of uniformity can be prevented only by planting pure seed.

Sorgo and some of the grain sorghums are excellent silage crops. Silage can be stored in trench silos at small expense.

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# THE CULTURE AND USE OF SORGHUMS FOR FORAGE*

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## IMPORTANCE OF SORGHUMS

THE SORGHUMS are for the most part natives of tropical Africa. The general culture of sorghum in the United States began, however, with the introduction of a Chinese variety, Chinese Amber, from France about 1855. The most important single shipment of sorghums was that of 16 varieties from Natal, South Africa, in 1857. Hundreds of lots of sorghum seed have been received from foreign countries since that time. At first, most attention was devoted to the growing of sorghums as a source of sugar and sirup. The settlement of the prairie lands in the semiarid West, however, created a demand for drought-resistant forage crops, and now about 90 percent of the acreage of sweet sorghums is grown for forage and the remainder for sirup. About 8,000,000 acres of grain sorghum and 2,000,000 acres of sorgo (sweet sorghum)[1] are grown annually in the United States. At least 5,000,000 acres of these are harvested for fodder and silage.

[1] The sweet sorghums usually are referred to as "cane" by farmers, but in this bulletin they are called sorgos. The word "cane" properly belongs to the sugarcanes, an entirely different group of plants, represented by the botanical genus *Saccharum*. The use of the term "cane" for the sweet sorghums leads to confusion in regions where sugarcane is commonly grown.

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Sorghums are especially valuable for winter feeding in the Great Plains where other forage crops are not well adapted. In severe winters in this area large numbers of cattle have been lost by starvation and exposure. Many of these losses could be prevented by growing sorghums and storing the surplus produced in good years either as fodder or silage for emergency use. If storage for more than 1 year is contemplated the crop should be put in a silo, because the loss in stacks is considerable. Trench or pit silos are inexpensive, are practically indestructible, and will preserve properly made silage almost indefinitely. Cattle that have access to straw and are fed on such silage with a protein supplement will come through the winter without excessive loss of weight. Silage is especially valuable for farmers who keep a few milk cows or operate a dairy. The utilization of sorghum fodder as silage is discussed more fully on page 35.

Sorghum is also often drilled or seeded broadcast as a supplementary hay crop. As such it may often be sown as a catch crop on land originally intended for other crops but which, because of wet weather, floods, or for other reasons, cannot be seeded at the proper time. In the Southern States, especially, it is used extensively to feed mules and to a lesser extent for other farm animals. Though somewhat laxative, it is nutritious, and they do well on it. In this area no other crop except Sudan grass and Johnson grass are equal to it for general farm feeding. Because it is often rather coarse and difficult to cure, it is not generally considered a good hay crop for market, although small quantities may be marketed locally.

Sorghum may also be grown as a soiling crop (i. e., cut and fed green), though care must be taken to avoid bloating and prussic acid poisoning, as discussed on page 37. Its value for soiling is due to its availability during periods of summer drought, when pasture and other green feeds are scarce. Sorghum may also be used for pasture, though its use for this purpose is not generally recommended because of the danger of prussic acid poisoning.

## AREAS SUITED TO SORGHUM PRODUCTION

The principal areas where sorghum was harvested for forage in 1934 are shown in figure 1. In the southern Great Plains sorghum is the most dependable forage crop. In most of western Texas, Oklahoma, and Kansas and in eastern New Mexico and southeastern Colorado it is the basic feed crop for livestock. East of the ninety-eighth meridian and north of the lined areas shown on the map (fig. 1), alfalfa, timothy, clover, and soybeans are more highly prized than the sorghums for hay, and corn usually can be depended on for grain, fodder, and silage. North and west of the regions where it is commonly grown, sorghum is not well adapted and is of little importance. Where sorghum is grown in the Pacific Northwest the Black Amber variety is most popular. In the southern two-thirds of the Great Plains sorghum varieties properly chosen can be depended on for both grain and forage. Except at high elevations, sorghums can, however, be grown as a secondary forage crop in all parts of the United States almost up to the northern boundary.

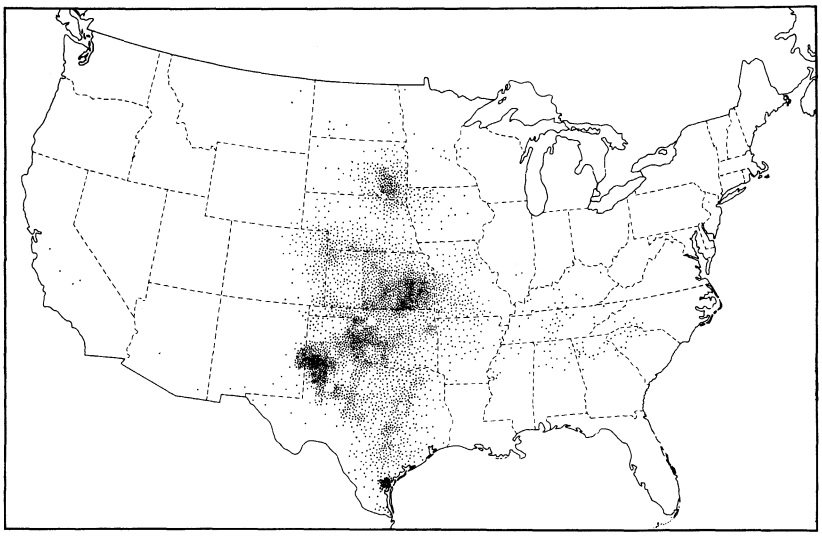

FIGURE 1.—Distribution of sorghum harvested for forage in 1934. Each dot represents 2,000 acres.

Sorghums do best in the southern half of the United States, where the temperatures are uniformly high during the growing season. The most favorable mean temperature for their growth is perhaps about 80°F., and they grow very little at temperatures below 60°. Cool temperatures prevent sorghums from being grown at very high altitudes. The limits of successful production are reached at altitudes of 5,000 to 6,000 feet in Wyoming and Colorado, and at 7,000 feet in Arizona and New Mexico.

Sorghums are not so exacting in their moisture requirements as in their temperature relations. Despite the fact that the largest sorghum area in the United States is in a region of low and uncertain rainfall, the crop thrives under irrigation and where the rainfall is abundant. Sorghums are grown extensively in the semiarid plains, not only because they require little rain but also because they are more productive than other crops under such conditions.

The sorghums are of most value in regions of uncertain rainfall, because they resist wilting and remain practically dormant during periods of drought and then resume growth as soon as there is sufficient rain to wet the soil. Sorghum plants have more secondary feeding roots and a smaller leaf area per plant than corn of comparable seasonal requirements. This combination of an efficient moisture-absorbing system with a reduced evaporating surface also accounts in part for their greater ability to withstand drought.

## SORGHUM AS COMPARED WITH CORN FOR FORAGE

Sorghum is rapidly replacing corn for silage in Kansas, Nebraska, Texas, Oklahoma, and western Missouri, and in other States where drought frequently injures the corn crop. In good seasons in these States the better varieties of forage sorghum frequently yield one-third to two-thirds more silage than corn, whereas under conditions of severe drought or grasshopper injury when corn is nearly a failure

sorghums may still produce 3 to 8 tons of silage per acre. Sorghum is more certain than corn in dry seasons, and a smaller acreage can be planted with reasonable assurance that sufficient feed to fill the silo will be produced. Experiments in several States indicate that sorghum silage is slightly inferior in feeding value to corn silage made from a crop in which the ears are well filled. This difference, probably due to a higher proportion of and a better utilization of the grain in corn, is much more than offset by the higher yields of sorghum. The relative advantages of corn, sorgo, and kafir silage expressed as pounds of beef or gallons of milk per acre are illustrated graphically in figure 2. The diagram shows in a striking manner

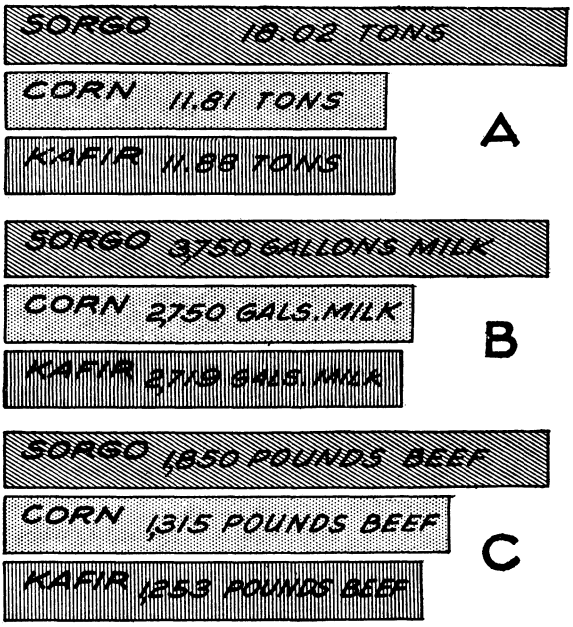


FIGURE 2.—A 5-year comparison of sorgo, corn, and kafir silage grown at Manhattan, Kans.

the high value of sorgo when utilized as silage. There is little doubt that some, though not all, of this superiority over corn is lost in the succeeding crop, for most investigators admit that corn leaves the field in better condition for wheat or other small grains than does sorghum (p. 5).

## SOILS

Sorghum thrives on a variety of soils. Deep fertile sandy loams are best, but fair crops can be produced on heavy clays if they are well drained. Land too poor and thin to grow corn or wheat seldom produces a satisfactory crop of sorghum, although sorghum frequently is planted on such land. In humid areas or on irrigated land a legume, like cowpeas or clover, should be substituted in the cropping system and the productive power of the soil restored by applications of commercial fertilizers or barnyard manure. Sorghum is more tolerant of alkali in the soil than most crops.

Sorghum has the reputation of being "hard on the land." This expression is commonly applied by farmers to crops that seem to have an adverse effect on the yields of succeeding crops. The belief that cotton, corn, oats, wheat, and other crops yield less on fields that have produced a crop of sorghum the previous year than on fields preceded by most other crops is supported by rotation experiments in many States. The difference in yield is approximately 15 percent.

Several factors contribute to the lower yield of crops following sorghum. The most important one in dry regions is probably the rather complete exhaustion of soil moisture by the sorghum. Another is the poor physical condition of the soil resulting from the large clumps held together by the numerous fibrous roots of sorghum. Under some conditions the soil in sorghum fields appears to be somewhat deflocculated. The continued growth of sorghum plants until killed by frost in the fall tends to exhaust available plant nutrients. On irrigated lands the chief deleterious effect on the soil after sorghum appears to be a deficiency of available nitrates. Large quantities of sugar remaining in sorghum roots are believed to stimulate the growth of micro-organisms in the soil which take up the nitrates in their bodies. After the sugars are used up the organisms die, and the nitrates are released for crop growth. The deficiency in nitrates can be largely overcome on irrigated land by the application of ample barnyard manure or other nitrogenous fertilizers.

Because of these various effects on the soil, fall-sown grain does not usually succeed well on sorghum stubble. It is best to follow sorghum with a spring-sown crop or summer fallow.

The deleterious effects of sorghum on the land are temporary and usually disappear after the first crop following the sorghum. In other words, sorghum has no permanent injurious effect on the soil other than the removal of plant food, such as would occur with other grain crops.

## FERTILIZERS

In the Great Plains, where the larger part of the sorghum acreage is located, but little fertilizer is used on sorghum or any other crop. The limiting factor in all this region is moisture and not soil fertility; consequently, the use of fertilizers does not pay. Even barnyard manure has been of little benefit to sorghums on most soils in the Great Plains.

In the Southeastern States any fertilizer known to be beneficial to corn under local conditions may be expected to be equally beneficial to sorghum. Where forage is the chief consideration it is desirable to have the nitrogen content of the fertilizer rather high. In the Cotton Belt it has been a common practice to apply 200 to 300 pounds of cottonseed meal per acre to land that is to be planted to sorghum.

Experiments carried on by the Alabama Agricultural Experiment Station showed that the highest yields of sorghum silage were obtained when a complete fertilizer analyzing 6–10–4 [2] or 6–20–4 was used. Phosphorus was most effective in increasing yields followed by nitrogen, potassium, and lime.

[2] 6 percent of nitrogen (N), 10 percent of phosphoric acid ($P_2O_5$), and 4 percent of potash ($K_2O$).

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On the basis of 9 years' experiments with Sagrain sorghum on the alluvial soils of the Yazoo-Mississippi Delta in Mississippi, where crops respond to additional nitrogen, an application of 150 pounds per acre of ammonium sulfate when the plants are approximately 12 inches high has been recommended.

At the Oklahoma Agricultural Experiment Station small increases in the forage yields of darso and kafir were obtained from the application of barnyard manure and phosphates.

## DESCRIPTION OF SORGO VARIETIES

The sorghums often are divided into four groups[3]: (1) Sorgos, or sweet sorghums ("cane"), used for forage and sirup; (2) grain sorghums (kafir, hegari, milo, etc.), used for grain and forage; (3) grass sorghums (Sudan grass and Tunis grass), used for pasture and forage; and (4) broomcorn, grown for its brush.

This bulletin deals largely with the sorgos, but also discusses grain sorghums commonly used for forage. The culture, varieties, and feeding of grain sorghums are described in Farmers' Bulletin 1764. The sorgos have sweet juicy stems and usually are 6 to 14 feet tall. The seeds usually are smaller than those of grain sorghums and are not especially desirable for feed because of their bitter taste and because a relatively larger proportion passes through the animal undigested. Only white-seeded varieties, such as Atlas, White African, and Tricker, are free from bitterness. Most of the sorgo varieties usually produce lower seed yields than the grain sorghums because of smaller seeds and heads and because on farms they usually are planted thicker. The smaller seed yield is offset by the taller and heavier growth of stalks as compared with that of grain sorghums. Sorgos usually yield 25 to 50 percent more forage than grain sorghums except under very dry conditions.

At least 30 distinct varieties of sorgo are grown in the United States. Among the most important are Sumac, Minnesota, or Black Amber, Red Amber, Atlas, several strains of Orange, Sourless, Honey, and Gooseneck.

### SUMAC

Sumac, usually called Red Top, is the leading variety of sorgo. It is grown extensively in Texas, Oklahoma, Kansas, and other States. Sumac has short, compact heads and very small dark reddish-brown seeds that thresh free from the hulls and is of midseason maturity. It is less subject to lodging, and the stalks are more easily handled and harvested than those of several of the taller varieties. This, together with its usual leafiness and satisfactory yields, accounts for its great popularity. It is seldom used for sirup and is generally considered unsatisfactory for that purpose. In western Kansas and a few other localities where the season is short the Early Sumac variety is preferred. This variety is slightly shorter and earlier than the regular Sumac, but otherwise they are nearly identical. A head of Sumac sorgo is shown in figure 3.

[3] For additional information on these groups see U. S. Department of Agriculture Farmers' Bulletins 1619, SORGO FOR PRODUCTION: CULTURE,, HARVESTING, AND HANDLING; 1126, SUDAN GRASS; 1764, GROWING AND FEEDING GRAIN SORGHUMS; and 1631, BROOMCORN GROWING AND HANDLING.

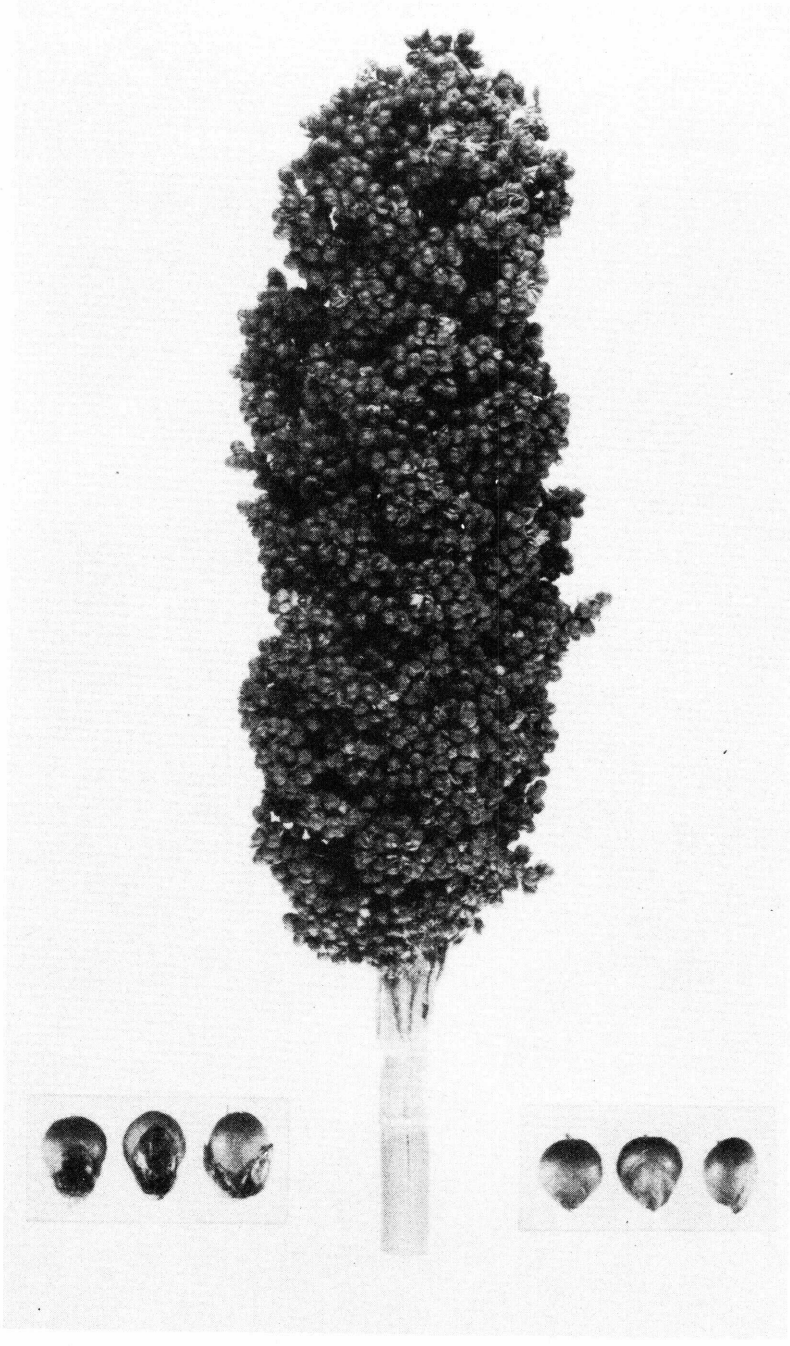

FIGURE 3.—Head and seeds of Sumac sorgo.

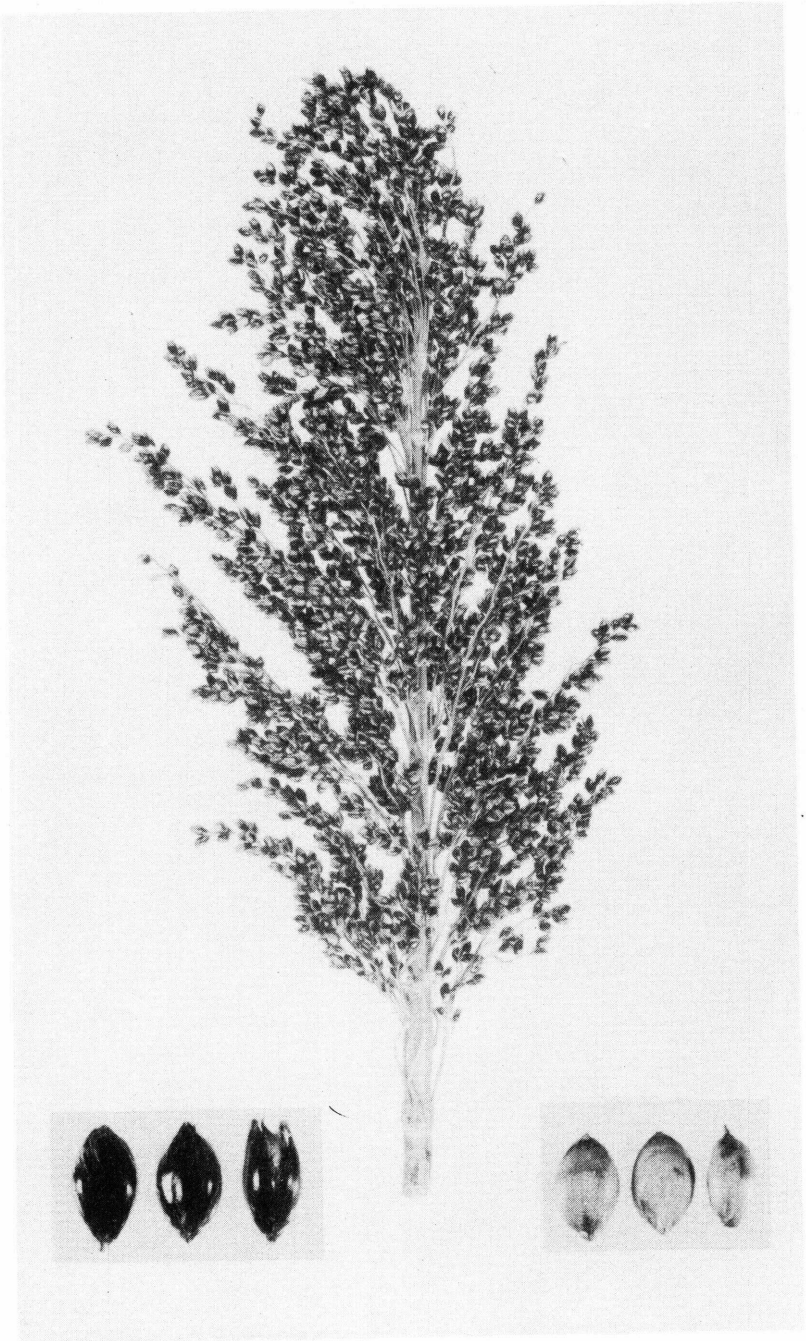

FIGURE 4.—Head and seeds of Minnesota Amber sorgo, a strain of Black Amber.

## BLACK AMBER (EARLY AMBER)

Black Amber, including various strains such as Minnesota Amber and Waconia Amber, is the leading sorgo grown north of the latitude of northern Kansas. It is grown extensively in Nebraska, Colorado, South Dakota, Minnesota, and northwestern Kansas, and to a limited extent in many other States. This variety is early in maturity and of medium height (usually 6 to 9 feet) and has slender stalks with rather few leaves. The heads are loose, open, and usually nodding (fig. 4). The seeds are light brown and after threshing are nearly all enclosed in the black shiny chaff. Black Amber sorgo is grown chiefly for forage, but it also is the leading type for sirup in the northern half of the United States, where other heavier-yielding types do not usually mature. It yields much less than later varieties where they mature, and the forage often is of poorer quality

FIGURE 5.—Blackhull kafir (left) and Red Amber sorgo (right).

because of the few leaves and because the stalks become dry earlier in the season.

Dakota Amber is shorter and earlier than Black Amber and is grown under the cool, dry, short-season conditions commonly prevailing in the Dakotas, Wyoming, and Montana.

## RED AMBER

Red Amber (fig. 5) is similar to Black Amber except that it has dark-red instead of black chaff on the seeds and is slightly later and heavier and slightly more compact. It is adapted to sections just south of where Black Amber is a leading variety. It is grown most commonly in southern Nebraska and eastern Colorado. It usually yields more and better forage than Black Amber where both varieties reach maturity, but south of northern Kansas it is inferior to many other varieties here mentioned that require a longer season.

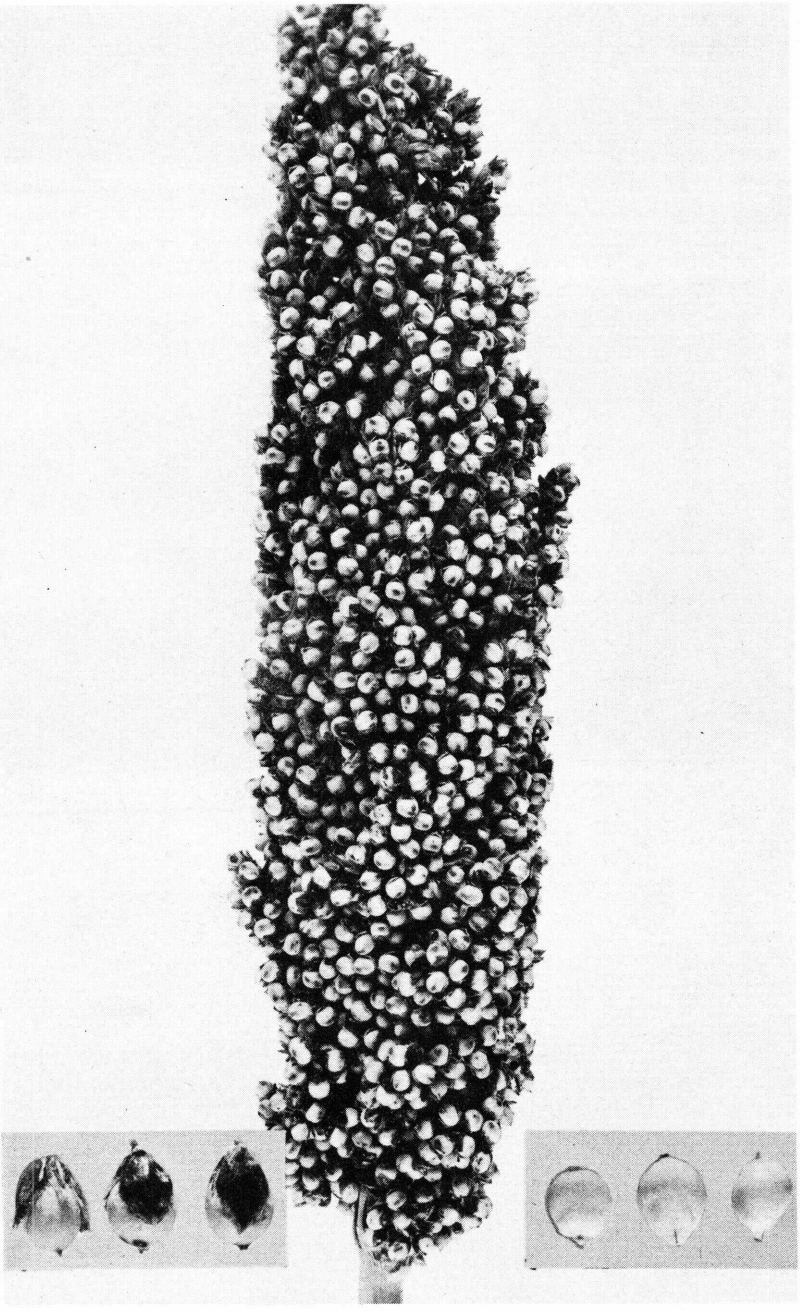

FIGURE 6.—Head and seeds of Atlas sorgo.

### ATLAS

Atlas sorgo was originated in Kansas by J. H. Parker, of the Kansas Agricultural Experiment Station and the United States Department of Agriculture, by selection from a cross between Sourless sorgo and Blackhull kafir made by I. N. Farr, a farmer of Stockton, Kans. It was distributed in Kansas in 1928 and now is very popular in the eastern half of Kansas and Nebraska and in western Missouri. It is gradually increasing in acreage in Oklahoma, Texas, Iowa, Kentucky, and other States. The Atlas variety is rather tall and late. (See title-page illustration.) It usually does not reach maturity where the frost-free period is less than about 170 days but matures and produces high yields of forage in most sections south and east of east-central Nebraska. It has strong stalks that lodge less easily than those of many of the tall varieties of sorgo commonly grown. The seeds are white, almost indistinguishable from those of kafir, a grain sorghum, and, unlike most other sorgos, it can be used readily as a grain feed.

Atlas (fig. 6) has sweet juicy stalks, but is rarely used for sirup making. The sirup is said to be more mild in flavor and paler in color than the consumer usually expects in sorghum sirup. Atlas combines the desired characteristics of a sweet forage sorghum with the white seeds and strong stalks of kafir to a large degree. It is taller and later and a heavier forage yielder than either parent from which it was produced.

The plant exhibits a remarkable tenacity, which enables it to remain green but dormant through long periods of drought and then resume growing when rains occur.

### ORANGE

Several strains of Orange sorgo are grown, and in addition the name Orange often is applied erroneously to several varieties. The original Orange variety apparently had black or dark reddish-brown chaff that faded somewhat after maturity and this with the yellowish-brown seeds made the ripe heads appear to be a sort of orange color. This variety, of medium height and maturity, is still grown widely, but rarely in pure form because of the many years of mixing and natural crossing. Authentic seed of this type of Orange is rarely found. The best-known definite strains of Orange are the Kansas Orange and Waconia Orange described later. The Colman variety usually is called Red Orange, and the Sourless variety is sometimes called White Orange.

### KANSAS ORANGE

The Kansas Orange variety is taller than Atlas and usually produces a slightly larger yield of forage. It is slightly earlier than Atlas, especially in a dry season. It is grown extensively in eastern Kansas and somewhat in other States but is being replaced rapidly by Atlas. It is regarded highly as a sirup variety.

Kansas Orange sorgo has rather small oblong heads, with dark reddish-brown chaff and rather small brown seeds (fig. 7). This variety has been well known for more than 50 years. The strain now grown was selected for yield and sugar content at the Kansas station more than 40 years ago.

FIGURE 7.—Kansas Orange sorgo.

## WACONIA ORANGE

Waconia Orange is shorter and earlier than Kansas Orange and has bright-red chaff and medium-sized yellowish-brown seeds. The seeds extend well out of the chaff and give the ripe heads a yellowish-red appearance. Under favorable conditions Waconia Orange grows to a height of 8 or 9 feet, but usually it is shorter. It is an important variety in Iowa, where it is popular for both sirup and forage. It is grown in other States as well. Waconia Orange was selected and distributed by a sorghum-sirup company at Cedar Rapids, Iowa.

## SOURLESS (AFRICAN MILLET)

The Sourless variety, called also African millet and White Orange, is grown extensively in southern Kansas and western Oklahoma, mostly badly mixed as to type. It is a popular variety for forage under conditions of limited rainfall. The seeds are mostly a pale buff with some mixture of white seeds. The yellowish-brown chaff fades out to a straw color at maturity. It is earlier and shorter than Kansas Orange. A head and seeds of Sourless are shown in figure 8.

## HONEY (JAPANESE SEEDED RIBBON CANE)

Honey sorgo is among the most popular varieties south of Kansas. It is late in maturity, with very tall thick stalks, large, open, brushy heads, and bright-red chaff that remains on the seeds after threshing (fig. 9). It is grown both for forage and sirup, and is one of the most productive varieties where the season is long enough and ample moisture is available to bring the crop to maturity. The

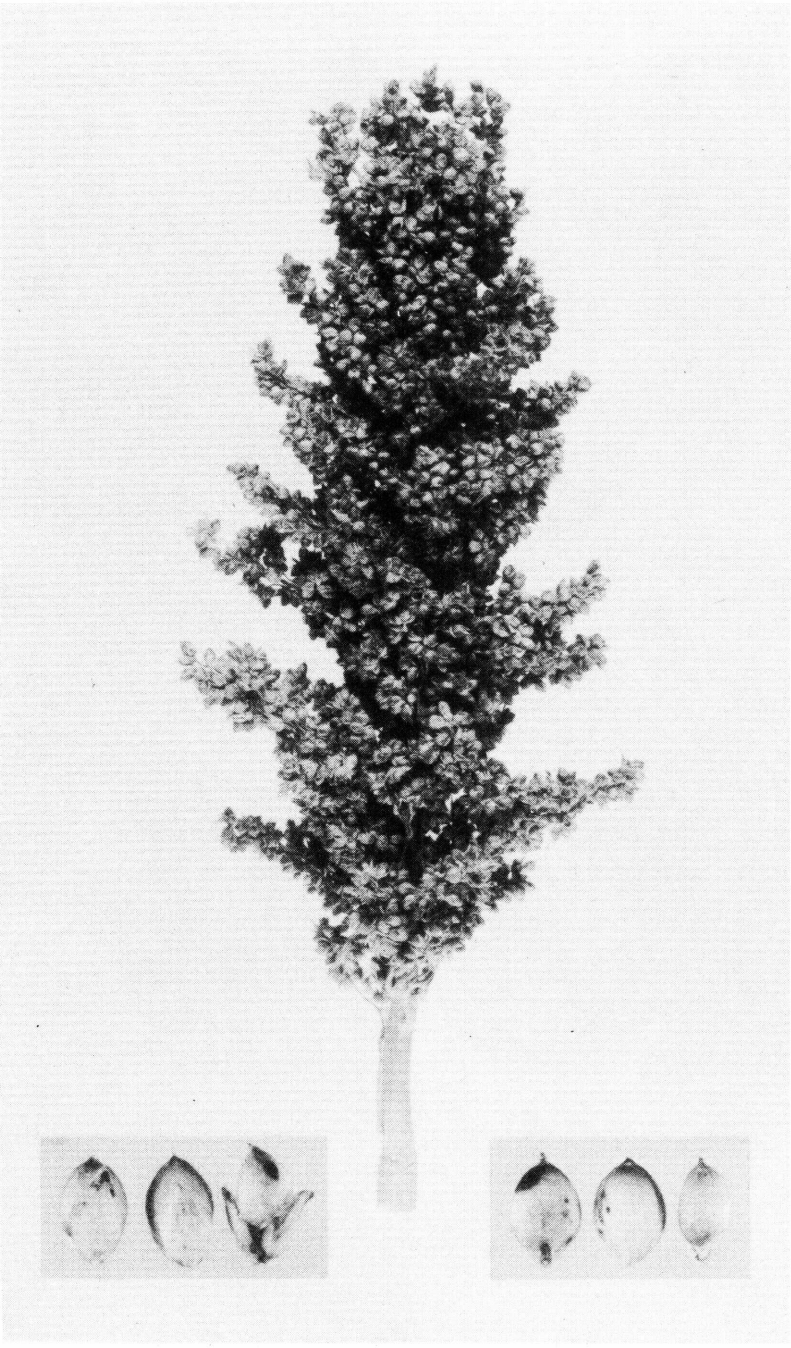

FIGURE 8.—Head and seeds of Sourless sorgo.

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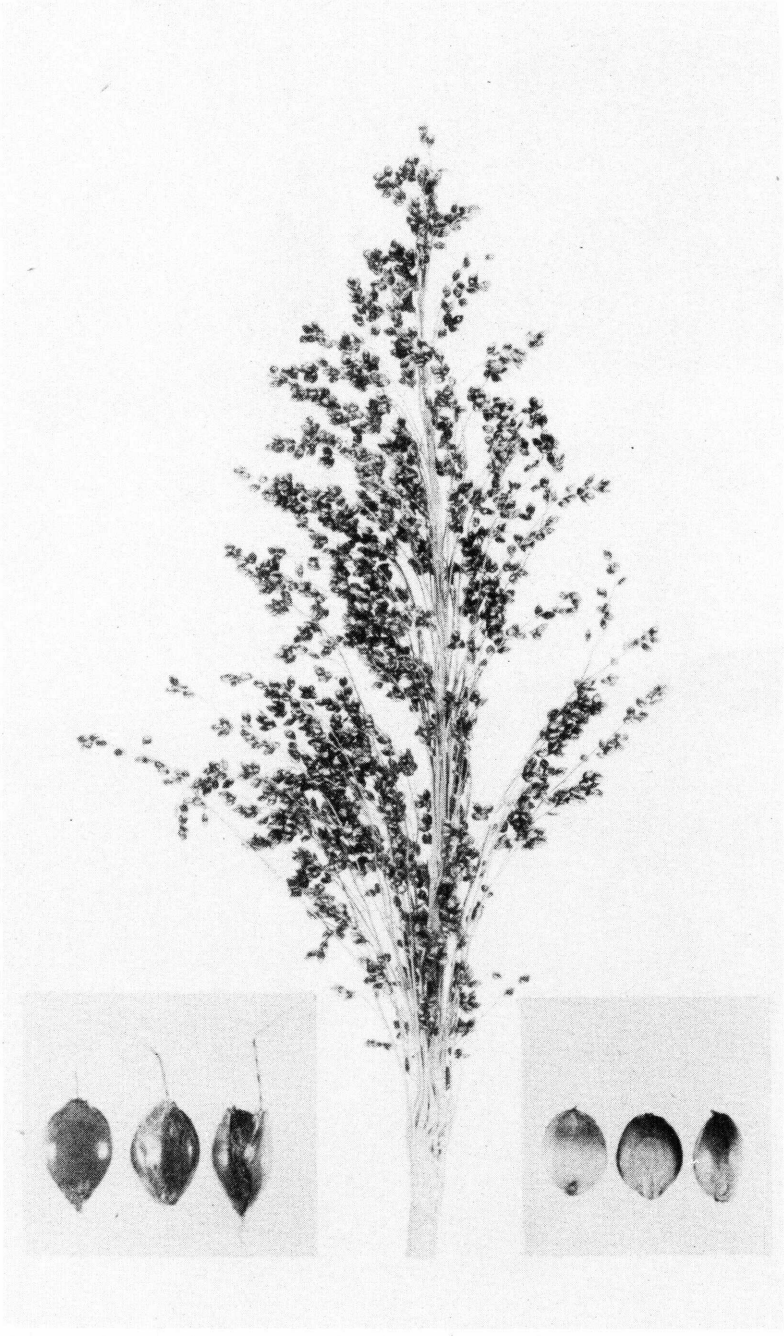


FIGURE 9.—Head and seeds of Honey sorgo.

Honey variety is known by many names, including Honey Drip, Japanese Ribbon cane, and Sprangle Top.

### GOOSENECK (TEXAS SEEDED RIBBON CANE)

The Gooseneck variety is the latest and largest sorgo grown in the United States, and, because of this, it is adapted only to the Southern States, where long growing seasons and ample moisture prevail; there the variety produces high yields of forage or sirup. The variety is distinguished by thick, compact heads that bend over and hang down, black chaff, and rather large brown seeds. The Gooseneck variety is most commonly called Texas Seeded Ribbon cane.

### OTHER VARIETIES

Among the other varieties grown for forage may be mentioned Leoti (Leoti Red), Tricker, and Fremont, which are relatively early and drought resistant. Leoti is adapted to western Kansas and is of good forage quality and resistant to red-spot diseases. Tricker, also grown in western Kansas, is so short and so low in forage yields that kafir, a grain sorghum, should be grown in preference to it. Seed of Tricker, owing to its similarity to that of Atlas, has frequently been sold fraudulently or mistakenly as Atlas. The forage yield of Tricker is not likely to be more than two-thirds that of Atlas. Fremont is an early variety adapted to northeastern Colorado.

A number of other varieties grown on a limited acreage are valued for sirup production as well as for forage by many farmers in the Southern States. Of these, White African (White Mammoth) (fig. 10) is about as tall and late as the Honey variety and has a simi-

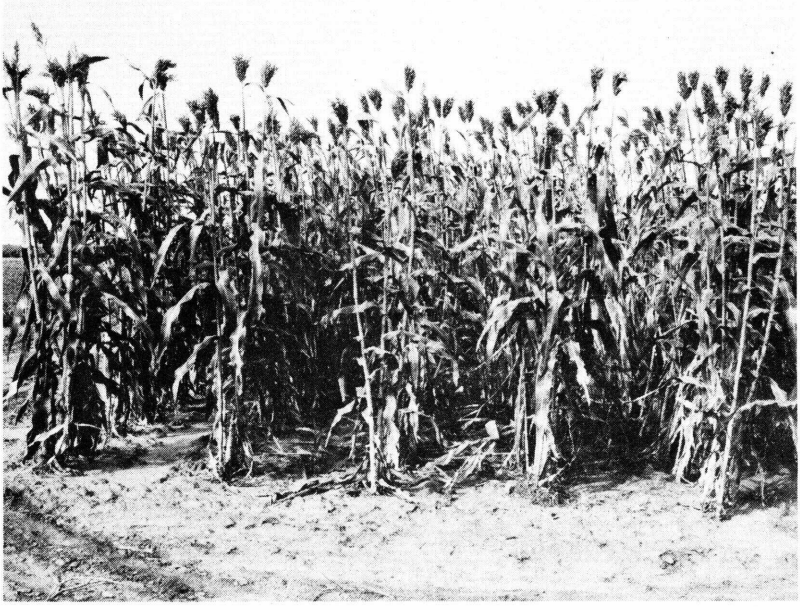


FIGURE 10.—White African sorgo.

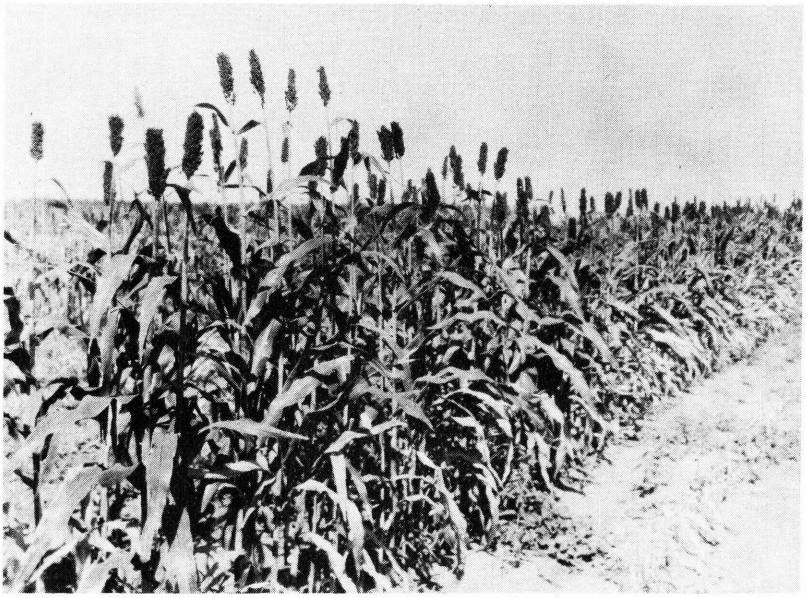


FIGURE 11.—Colman sorgo.

lar adaptation. Colman (Red Orange) (fig. 11), Planter (Planters' Friend), Sapling, Sugar Drip, Rex (Red X), Folger (Folger's Early), Collier, McLean, Denton, Dwarf Ashburn (Dutch Boy), Straightneck, and Clubhead are medium late in maturity and, with the exception of Dwarf Ashburn, are rather tall. These varieties produce a satisfactory yield and quality of forage, although they are not particularly superior to the more popular varieties previously mentioned. They are planted for forage purposes chiefly because seed is available locally.

## GRAIN SORGHUM VARIETIES FOR FORAGE

Grain sorghums are of most importance in the southern Great Plains and the irrigated portions of New Mexico, Arizona, and California. Some of them, such as hegari (fig. 12) and the kafirs (Blackhull, Sunrise (fig. 13), Red, Dawn, and Pink), and some others, such as Grohoma, darso, and Freed, may properly be considered as dual-purpose sorghums, since they produce good yields of grain and also are satisfactory for fodder or bundle feed. Others, such as the milos, the durras, shallu, and usually feterita, have stalks so dry and unpalatable that they are seldom used for forage. There is always considerable waste in feeding them unless they are chopped, and at best they are far inferior to the sorgos. More than 40 percent of the total acreage of grain sorghum is harvested for fodder or bundle feed. In exceptional years, when drought or early frosts prevent its development into a good grain crop, the proportion of kafir utilized as forage has been estimated at more than 80 percent of the acreage in certain States. The grain sorghum varieties are described briefly in Farmers' Bulletin 1764.

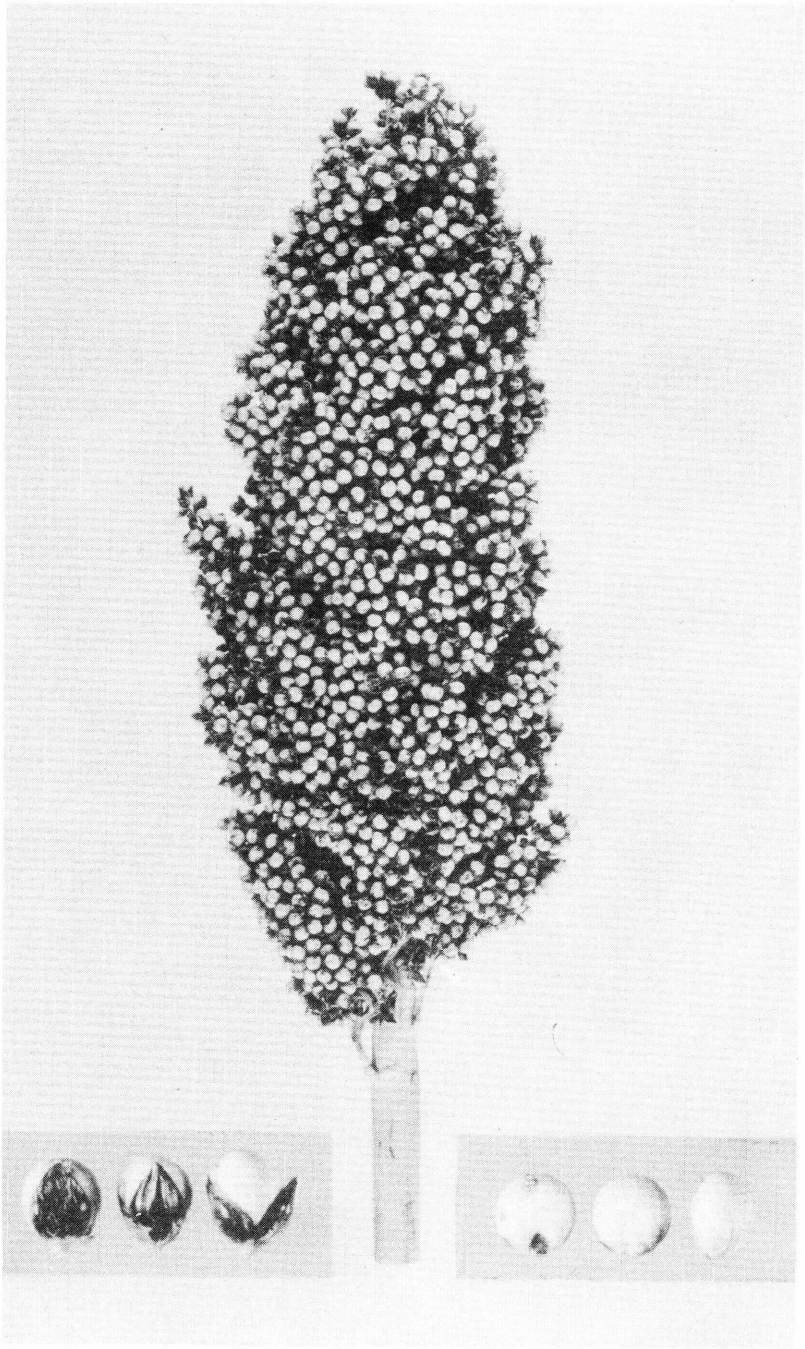


FIGURE 12.—Head and seeds of hegari.

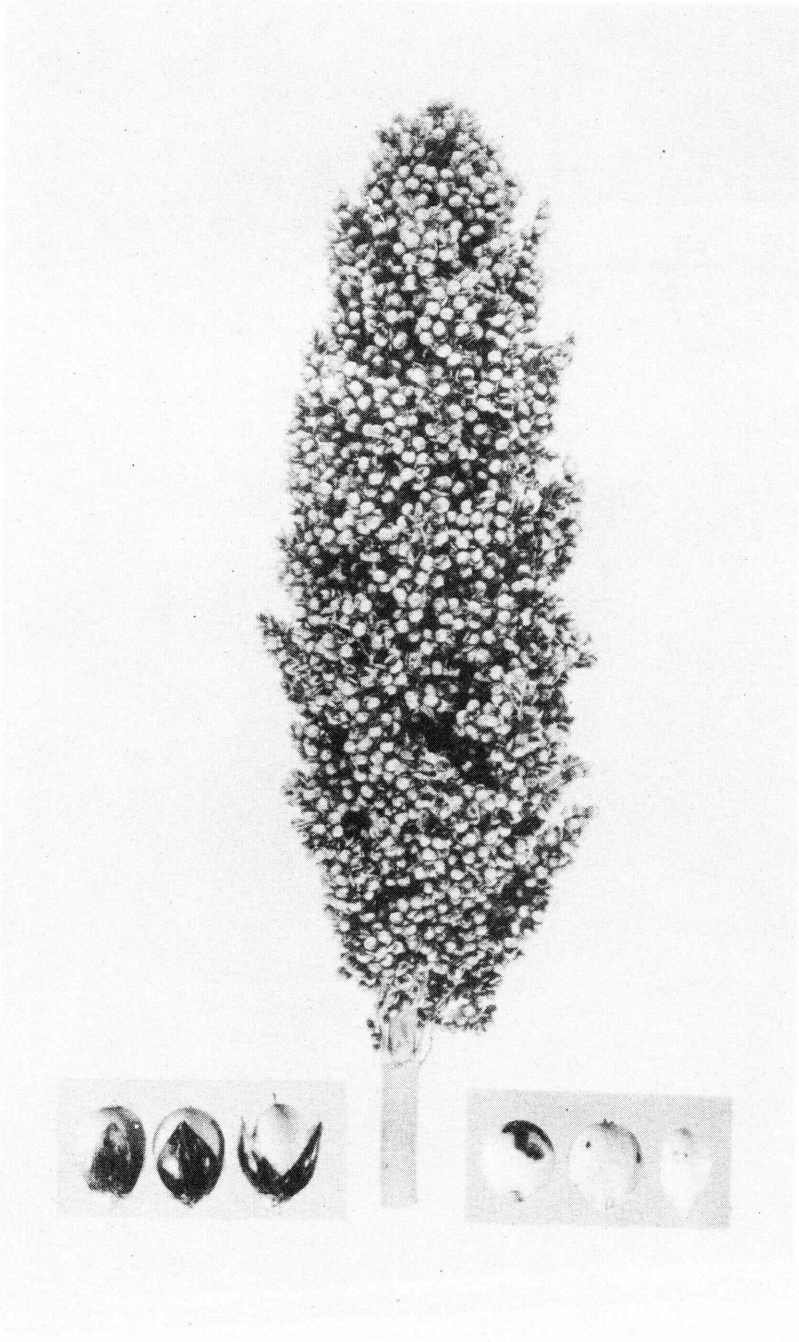


FIGURE 13.—Sunrise kafir.

The grain sorghums listed above usually yield about two-thirds as much forage as do well-adapted varieties of sorgo. There are certain advantages in growing them for forage, however, because the bundles can be topped after harvest and the heads threshed or ground if grain is desired and the yield of grain is satisfactory. When most of the stalks fail to produce heads they are harvested for forage without subsequent topping of the stalks to remove the heads.

Many farmers in the Southwest prefer a grain sorghum, such as hegari, to the sorgos, because it can be utilized as a grain crop in seasons of favorable rainfall and yet be utilized for forage if it does not promise a profitable grain yield. Some of the grain sorghums are therefore included in the varieties recommended for the different regions. For forage alone the sorgos are preferable to the grain sorghums, but in many instances other considerations, such as the supplementary grain and the ease of handling, cause the growing of grain sorghums for forage.

Another important practical advantage of the grain sorghums for forage is the shorter stalks, which make harvesting, shocking, loading, stacking, and feeding much less laborious than are the same operations with the taller sorgos. The feeding problem also is simplified when a single bundle of grain sorghum weighing 10 to 15 pounds furnishes a suitable quantity of both grain and forage for one feed for an animal. Farmers in southern Arizona, and in other sections where the crop is well adapted, regard hegari highly for silage because this crop contains a greater proportion of grain than does sorgo.

## SORGHUM VARIETIES RECOMMENDED FOR DIFFERENT AREAS

There are many varieties of sorghum and they differ greatly in various characteristics, such as time required to mature, ability to endure drought, response to abundant rains, etc. It is fully as important to minimize the effect of adverse climatic conditions by a wise choice of varieties as it is to create more favorable conditions by means of irrigation or improved methods of culture. In no part of the United States is the truth of this statement more often confirmed than in the semiarid portion of the Great Plains where the rainfall is undependable and where sorghums are generally recognized as the basis of a permanent diversified agriculture. An intelligent selection of varieties is the best insurance against failure. The time of maturity of a sorghum variety is the chief factor determining its adaptation to a particular locality. Early varieties are grown in the North and late varieties in the South, where a longer growing season and warmer weather permit the late varieties to mature. The earlier the variety the less forage it will yield under ordinary conditions. When sown broadcast or in cool climates, or in a dry season, when the development of all plants is retarded, large late varieties lose this advantage. In general, a variety should be grown that will reach maturity shortly before frost or when the soil moisture becomes exhausted.

The most reliable varieties for each part of the sorghum area are indicated in the following paragraphs, which refer to the map (fig. 14).

REGION 1.—Gooseneck and Honey sorgos: Japanese sugarcane and Napier grass are more productive than sorghums for forage. Shallu is the leading grain sorghum.

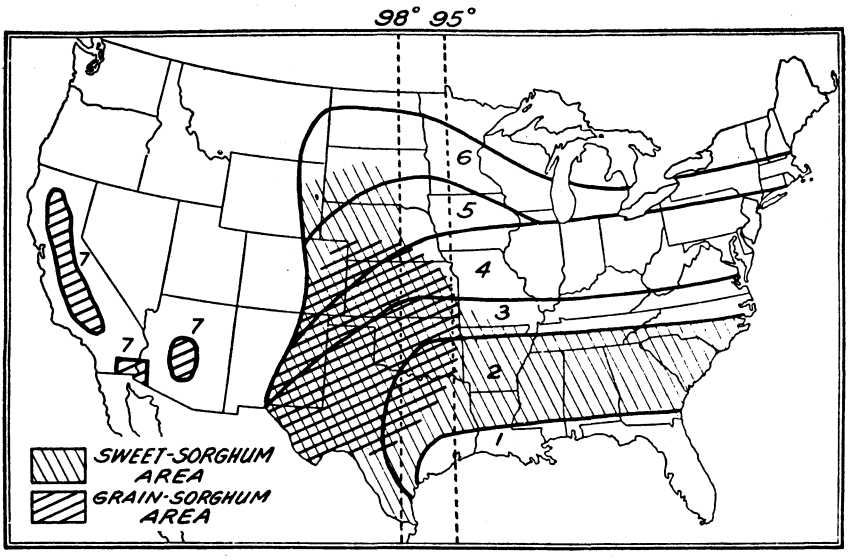



FIGURE 14.—Map showing sorghum regions in the United States.

REGION 2.—Sumac, Orange, Honey, Gooseneck, White African, Sugar Drip, Rex, Colman, and Sapling sorgos. The grain sorghums hegari, Schrock (Sagrain), Ajax, darso, Blackhull kafir, and Grohoma are suitable dual-purpose types.

REGION 3.—Sumac, Atlas, Kansas Orange, and Sourless (African millet) sorgos. Hegari, Blackhull kafir, darso, several strains of Dwarf Blackhull kafir, Hydro kafir, Red kafir, Pink kafir, Sunrise kafir, and occasionally Spur feterita are grown for forage and grain.

REGION 4.—West of the ninety-eighth meridian: Sorgos: Early Sumac, Leoti, and Sourless; grain sorghums for forage: Pink kafir, Dwarf (Western) Blackhull kafir, Dawn kafir, Sunrise kafir, and Freed. East of the ninety-eighth meridian: Sorgos: Atlas, Kansas Orange, Waconia Orange; grain sorghums for forage: Blackhull kafir, Pink kafir.

REGION 5.—Sorgos: Black (Early and Minnesota) Amber, Early Sumac, Red Amber, Dakota Amber, Waconia Amber, Fremont, Atlas, Kansas Orange. Grain sorghums for forage: Greeley, Cheyenne, Freed, Dawn kafir, Pink kafir, Highland Improved Coes, and Early Kalo.

REGION 6.—Sorgos: Black (Early and Minnesota) Amber, Dakota Amber, Red Amber, Fremont. Grain sorghums for forage: Cheyenne, Freed, Greeley, Highland Improved Coes.

REGION 7.—Sorgos: Honey. Atlas, Gooseneck. Grain sorghums for forage: hegari.

The varieties named for the various regions shown in figure 14 are recommended on the basis of the normal-planting date. When it becomes necessary for any reason to plant after the most favorable date it is then often desirable to use an earlier-maturing variety.

## DATE OF PLANTING

Generally the highest quality of forage will be obtained if the crop is planted so as to mature shortly before frost. An early planted crop is likely to encounter periods of drought after the plants have reached an advanced stage, and the lower leaves will die and break off. The forage is easier to cure without souring

when cut during cool fall weather. In the southern part of the sorghum region, where there is danger of injury to the grain by the sorghum midge, the crop should be planted as early as climatic and soil conditions permit—usually early in March. If forage only is desired, however, planting may be done at any favorable time up to July 15. Farther north the seeding should be delayed until May. In the latitude of Oklahoma and Kansas, May 15 to June 15, on the average, is the best period for planting. A safe rule in all localities, except where the sorghum midge is troublesome, is to plant not earlier than about 2 weeks after corn-planting time. All sorghums are sensitive to cold soils and grow slowly until the soil becomes thoroughly warm. No advantage is gained, therefore, by planting too early.

## METHODS OF PLANTING

Perhaps 85 percent of the sorghum acreage is planted in rows sufficiently far apart to permit cultivation with an ordinary corn cultivator. When the sorgos are grown for hay they usually are sown broadcast or drilled with a grain drill (fig. 15).

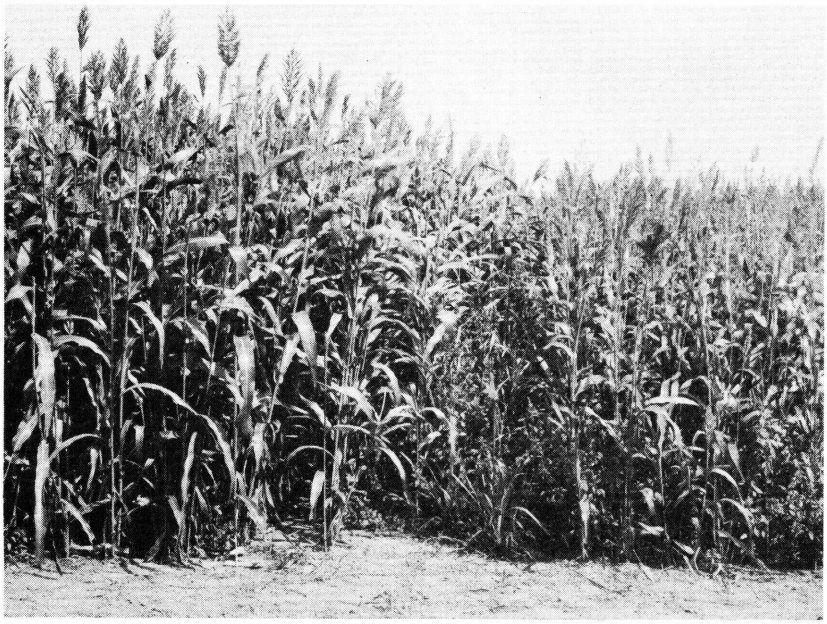


FIGURE 15.—Sorgo drilled for hay. Left, sown at the rate of 15 pounds, and right, at the rate of 75 pounds per acre.

This is not done in regions subject to severe drought or where grain drills and mowers are not already available. There is very little difference in forage yield between drilled sorghums and those planted in rows to be cultivated.

The advantages in sowed (drilled or broadcasted) plantings over cultivated row plantings for hay lie in the fact that no cultivation is needed after seeding and that the hay produced is finer stemmed.

The greatest drawback to such seedings is the failure of the sorghum to attain satisfactory growth in seasons of low rainfall. The crop is much more likely to head in cultivated rows than in drilled or broadcasted seedings.

For planting in rows, two general methods are followed—surface planting and listing or planting in furrows. The first method is best suited to regions of moderate rainfall and the latter to dry regions.

Usually in surface planting the ground is prepared by plowing and harrowing, as in preparing ground for corn (fig. 16). If, however, the soil is left clean and mellow by the preceding crop, it may be possible to prepare it by disking or one-waying.

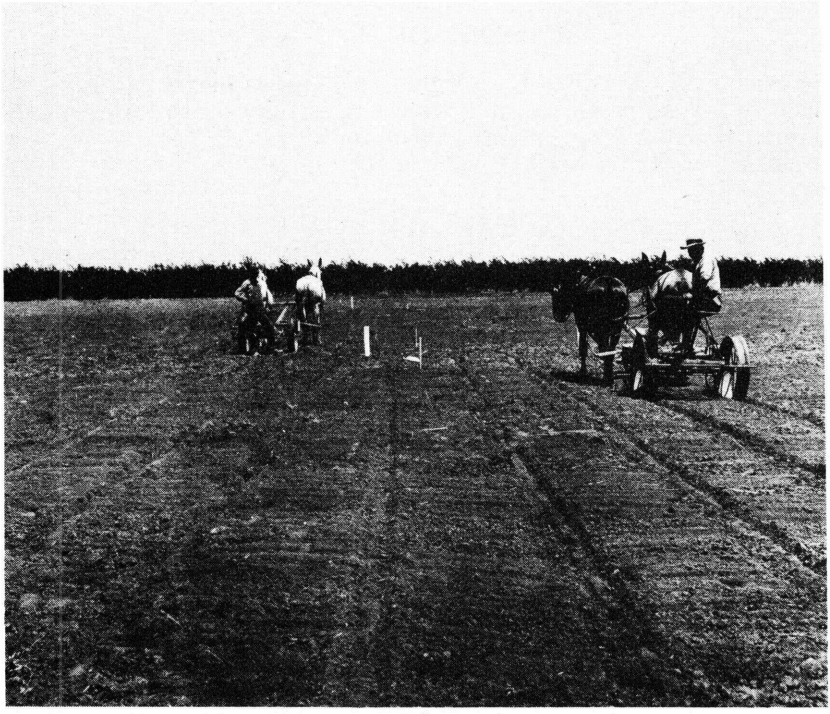


FIGURE 16.—Planting sorghum with a surface planter.

The ordinary corn planter, if provided with sorghum plates, will plant the seed satisfactorily. In order to distribute the seed evenly and to keep the plates from becoming stopped up, the holes for seed of forage sorghum should be from about three-sixteenths to one-fourth of an inch in diameter and should be reamed out on the lower side. The size of the hole to use depends upon the variety. Blank plates can be purchased and drilled to the desired size. The number of holes in the plate can be varied from 12 to 24, in order to give the desired stand; or the number of seeds dropped may be regulated by changing the speed with which the plate revolves

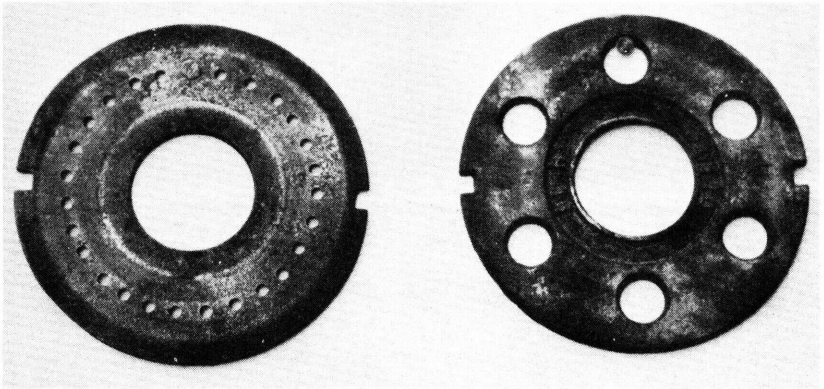


FIGURE 17.—Plates used for planting sorghum (left) and corn (right).

(fig. 17). Very little sorghum is checkrowed, as it has been found better to distribute the seed evenly in the row than to drop it in hills.

When a lister is used, sorghum may be planted successfully on grain stubble without much previous preparation, although this is not a recommended practice. Ordinarily, it pays to blank-list, disk, or both in the spring before planting with a lister. Experiments at Hays, Kans., on rather heavy soil have shown best average results when fall or early-spring listing was followed by spring cultivation necessary to destroy weeds, and the ground was then listed again at planting time by opening up the old furrows. Listing should be done on the contours or on level or nearly level land at right angles to the prevailing winter and spring winds, in order to catch snow and keep the soil from drifting.

Plates similar to those used in the surface planter are required for the lister. Sorghum planted with a lister usually starts growth more slowly in the spring, because the soil does not warm so quickly at the bottom of the furrow. The roots are deeper in the soil, however, and after the rows and middles are leveled by cultivation there is less danger of lodging during a hard blowing rain. Listed sorghum, though making a poor appearance in the early part of the season, is often more productive in the end than surface-planted sorghum if the season is dry.

Another advantage of the listed sorghum lies in the greater ease of keeping the weeds out of the row. The lister throws most of the weed seed out of the furrow and, by proper cultivation in the spring, the weeds between the rows can be effectually destroyed in two cultivations. In surface-planted fields it is very difficult to remove the weeds in the rows without injuring the young sorghum plants, and four cultivations are often required to keep the crop clean. The western farmer who handles a large acreage is anxious to reduce the labor required, and this fact has induced many to use the lister in preference to the corn planter (fig. 18).

An attachment to an ordinary corn planter that has been found especially useful in planting sorghums is the furrow opener. Two disks set just in front of the planter shoe open a broad shallow furrow, allowing the seed to be dropped in moist soil (figs. 19 and 20). The

FIGURE 18.—Planting kafir with a two-row lister.

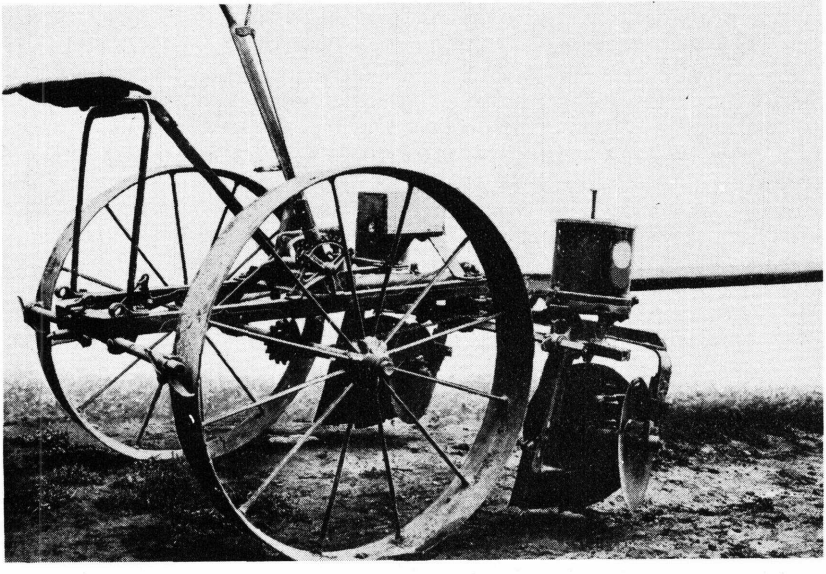


FIGURE 19.—Corn planter with disk-furrow openers attached.

FIGURE 20.—Field planted with disk-furrow openers.

soil in such furrows warms quickly, germination is prompt, the young plants grow rapidly, and the stands are not destroyed by washing so frequently as in lister furrows. On the other hand, weeds can be killed as easily as in lister furrows. The method combines many of the advantages of listing and surface planting and for that reason is finding favor with farmers in the eastern part of the district where the lister has been so generally used.

In the Southeastern States, where moisture is often excessive, a common practice in growing sorghum and other crops in rows is to plow the land and throw up beds with a lister. The crop is then planted on top of the bed or ridge instead of in the lister furrow, as is the practice in dry regions.

The preparation of land for broadcasting sorghum or planting with a grain drill is practically the same as for surface planting in rows. The land should be harrowed thoroughly after plowing. If the plowing has been done early in the spring it is best to disk or one-way the land immediately before planting so as to destroy the weeds that have started. This is highly important because if the weeds are not destroyed they develop with the crop and not only interfere with the growth of the crop but lower the quality of the hay obtained. Most farmers plow the land just before planting, in order to avoid this extra working of the soil.

## RATE OF PLANTING

### PLANTING IN CULTIVATED ROWS

The rate of planting sorghums in rows is of more importance when the crop is grown for grain than when it is grown for forage. The sorgo varieties stool or tiller freely. When soil moisture is abundant and the stand is thin each plant produces a large number of tillers, whereas if moisture is deficient the plant tillers less. This habit tends to equalize in a measure differences in the initial stand.

A large number of carefully conducted tests at agricultural experiment stations in the Great Plains have indicated that the largest forage yields are obtained when the plants are spaced about 2 to 4 inches apart in the rows.

If yield of grain is an important consideration, as when dual-purpose grain sorghums are grown for feed, a spacing of 6 to 8 inches is usually most satisfactory. The development of the plants is more nearly normal and the proportion of grain is greater than with thicker stands. In general, a 2- to 4-inch spacing for sorgos and a 6- to 8-inch spacing for grain sorghums when grown for forage is recommended.

If every seed placed in the soil grew, 1 pound of seed of the Sumac variety or 1½ pounds of Amber sorgo to the acre would be sufficient to provide one plant for every 4 inches in rows 40 inches apart, but it has been found necessary under farm conditions to plant at least 3 to 4 pounds of seed to insure such a stand. In the drier parts of the sorghum region it is rarely, if ever, desirable to plant more than 4 pounds to the acre, and 2 to 3 pounds usually is sufficient. Farther east, where the rainfall is between 35 and 40 inches, it has been found preferable, when growing the crop for fodder or silage, to plant as much as 8 to 12 pounds per acre.

### CLOSE DRILLING OR BROADCASTING FOR HAY

It has been the general practice among farmers to sow from 45 to 60 pounds of sorgo seed to the acre in close-drilled or broadcasted seedings. A 5-year test at one field station in Kansas and two in Texas has developed the fact that very little difference in yield is obtained whether one uses 15 pounds or higher rates up to 75 pounds of seed to the acre (fig. 4). The 15-pound rate, however, gives a coarser growth, which is more likely to be infested with weeds, especially if the seedbed conditions are not the best or the weather is not favorable for good germination of the seed and a vigorous early growth of the plants. It is recommended, therefore, on this basis to sow 30 pounds per acre west of the one hundredth meridian in the Great Plains, 45 pounds between the ninety-eighth and one hundredth meridians, and 60 to 75 pounds east of the ninety-eighth meridian.

## CULTIVATION

The early growth of sorghum is slow, and the young plants therefore require care to prevent their being crowded out by weeds. Where the field has been plowed late in the spring and then surface-planted, a common practice is to cultivate once with a spike-tooth harrow soon after the sorghum has emerged and later with an ordi-

nary shovel cultivator, as may be necessary to control weeds. In other words, the crop is handled much the same as corn is in the same area.

Listed sorghum is usually cultivated with special disk and knife cultivators, some of which handle two or more rows at a time. A "curler," which is a special kind of disk and shovel cultivator, is used most frequently (fig. 21). Another implement, called a "go-devil," consists of paired sled runners that straddle the plants but run inside the furrow with a knife and a gang of small disks attached to the outside of each runner. With either implement the disks are set to throw the earth away from the plants in the first cultivation and toward the plants in later cultivations. On the curler are small shovels that kill the weeds next to the row, and similar shovels are

FIGURE 21.—Monitor two-row disk and shovel cultivator ("curler") for listed sorghum.

often attached to the go-devil. The throwing-out operation cuts off the weeds in the furrow and buries those on the ridges. Throwing-in cuts off weeds on the ridges and buries those in the furrows.

Knife cultivators also are on the market (fig. 22). Some of these cultivate two or more rows at a time and are reasonably efficient. In listed plantings a cultivator with knives on each side, designed to cut under the weeds, is especially efficient in killing those on the edge of the furrow. A home-made cultivator of this sort, called a knife sled, is made by attaching heavy steel blades 30 to 40 inches long to a narrow sled, the runners of which are 2- by 10-inch planks at least 5 feet long and only 8 to 10 inches apart. One of these blades is bolted to each side of the sled, so that they extend backward at an angle of about 45°. These blades should be 4 or 5 inches wide and should be sharpened along the entire front edge. Attached in directly opposite positions, they have a spread of approximately 4

feet 6 inches. When the sled is running in the furrow the knives cut through the ridges on each side a little beyond the center, thus entirely freeing these spaces of weeds. If the knives are set at the proper angle they will maintain a fairly constant depth and free themselves from roots and trash, the operator riding meanwhile on the sled.

A harrow often is used to cultivate listed sorghums when the weeds are small, usually at the first cultivation or after the first cultivation with one of the cultivators described above. After the sorghum is 10 or 12 inches high a shovel cultivator can be used. Late cultivations should be shallow in order to avoid breaking the feeding roots.

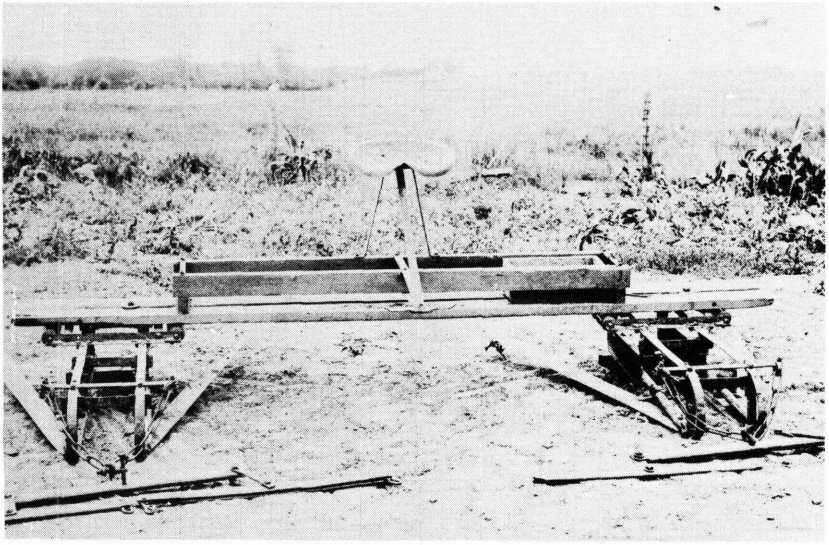


FIGURE 22.—Knife cultivator, or sled, used to cultivate listed sorghum.

## HARVESTING

Sorghum should be fairly mature before being cut for forage. There are several reasons for this: (1) The largest tonnage of dry matter is obtained from mature sorghums, (2) the feed is more palatable, (3) the plants contain less prussic acid, (4) the fodder does not sour in the shock so easily, and (5) the silage made from mature sorghum contains less acid and does not spoil when properly ensiled.

By the time sorghum has reached the beginning of the heading stage the plants practically have ceased taking up nitrogen and minerals, and very little more fiber is formed. Starch, sugars, and fats continue to be manufactured until maturity, and the total dry weight of the plants may increase about 40 percent between first heading and maturity. This increased weight is largely in the seeds and heads and in sugar stored in the stems. Experiments in which cuttings were made at different stages of maturity show that not only the largest quantity of cured forage is obtained when the crop is

harvested after the seeds are well formed but also the highest acre yield of protein, carbohydrates, and fat. In general, the best time to cut sorghum for fodder is when the seeds have reached the hard-dough stage.

The most efficient machine for harvesting sorghum in rows is a corn or row binder (fig. 23). A farmer, assisted by two men to shock the bundles, can harvest 6 to 7 acres per day. When once carefully shocked, sorghum keeps in good condition until late in the winter and can be hauled to the barnyard to be fed or stacked whenever other work is not pressing.

A long period for curing in the shock is necessary in the production of good sorghum fodder. Some difficulty is experienced in cer-

FIGURE 23.—Harvesting sorghum with a corn (row) binder.

tain sections with souring in the shock. This usually is the result of cutting the sorghum while it is immature.

Sorghum bundles should be stacked during periods when the humidity is high, in order to avoid excessive loss of leaves. Also the bundles pack better, and a well-formed stack can more easily be built. Care must be taken that the fodder is not too wet, or there will be some spoilage.

In the Southeast, where row binders are not generally available, the most common method of harvesting sorghum grown in rows is to cut the standing plants near the ground with corn knives and place them in shocks to cure.

When the crop is intended for silage a row (corn) binder ordinarily is used. The securely tied bundles are much easier to haul to the silo than loose stalks cut with a corn knife. In recent years the field silage cutter (see fig. 28), which eliminates much hard labor, has become popular.

Sorgo seed is harvested in the same way as the seed of grain sorghums. The most economical method is to use a grain header, but much of it is still gathered by hand from standing stalks in the field or after the crop has been cut with a row binder and shocked.

Broadcasted or drilled sorgo "sowed cane" is usually harvested as a hay crop with a mower. In dry climates farmers often harvest with a binder, but unless very dry weather prevails there is danger of spoilage in the bundle. Care must be observed in curing the sorgo when it has been cut with a mower, as the stems are very juicy, and it takes a long time to cure them sufficiently to be ready for the stack. It is best to allow the crop to lie in the swath for a day or two, then rake into windrows, and leave at least 4 days, or longer, if the weather is not favorable for curing. As soon as the leaves are fairly dry the hay may be placed in cocks to complete the curing process. The usual method is to bunch the hay into large cocks with a buck rake or dump rake. If cut in warm weather the stalks may sour. For this reason planting so that the crop may be cut during cool weather just before frost is advisable. So far as practical, drilled or broadcasted sorgo should be allowed to form seed before it is harvested except when it has been severely injured by drought and the plants dry up in the field.

## SEED PRODUCTION

Much of the sorgo now grown, with the exception of the Sumac variety, is badly mixed. Pure seed is difficult to obtain except from specialized seed growers and often is mislabeled as to variety. When sorgo is grown strictly for forage a high degree of purity of variety is not important, especially if the crop is drilled or broadcasted for hay. The varieties in the mixture should be enough alike, however, to reach the desired stage of maturity at approximately the same time. Otherwise there will be a loss in quality as well as in yield. In the growing of Atlas and other sorgo varieties having special qualities or purposes, or in growing sorgo for sirup, it is highly important to secure pure seed of the correctly named desired variety. This is best assured by purchasing seed from a grower or dealer who has had the fields inspected by someone competent to identify the variety.

For his own seeding the farmer may use heads selected in the field before frost. This seed, even though slightly immature, will germinate well if the heads are thoroughly cured by being hung on wires in the barn loft or granary. The practice of curing ears of seed corn in this way is common among corn growers. All sorghums cross-pollinate freely in the field. The sweet sorghums are more often mixed as to variety than are the grain sorghums because the seed crop is of less importance than the fodder. A special effort is therefore necessary to produce pure seed. Where a field is intended for seed production it should be rogued carefully, as the presence of stray plants of other varieties will permit hybridization. This crossing of varieties results in a lack of uniformity in ripening as well as in the size of the plants, thus causing difficulty in harvesting and loss in marketing the crop. Extra care in saving sorghum seed is justified, as there is a considerable demand for good pure seed of standard sorgo varieties, such as Black Amber, Sumac, Atlas, Honey, and Gooseneck.

In growing pure seed, certified, registered, or foundation seed should be planted, and the field should be separated by 40 rods or more from any other kind of sorghum, including broomcorn and Sudan grass. The purity of sorghums can be maintained only by complete isolation or by "selfing" individual heads. The latter is accomplished by fastening a paper bag over each head before it blooms, in order to exclude all pollen except that produced on the bagged head. Such a procedure is not practiced on a large scale, but may be resorted to for the production of pure seed for a seed plot.

Large quantities of the harvested heads thrown together in a crib or bin are likely to heat and lose their germinating power. In dry climates they may be piled in narrow ricks in the open, but it is better to place these ricks under cover. Damp or immature seed may be rendered worthless for planting if subjected to freezing temperatures.

An ordinary grain separator, if properly adjusted, can be used effectively for threshing. To avoid cracking the seed it is best to remove all but two or three rows of concave teeth and reduce the speed of the cylinder to about half that used in threshing wheat, but with the other moving parts operating at the speed used in wheat threshing. The distance between the cylinder and the concaves should be increased when threshing soft-grained sorghums like hegari and reduced for sweet sorghums, which are harder to thresh.

## SORGHUM-LEGUME MIXTURES

The practice of seeding mixtures of sorghum and some legume, such as cowpeas, soybeans, or velvetbeans, when forage alone is desired is commendable in theory, but in actual practice has not been a complete success. On the Great Plains, where the rainfall is deficient, the sorghums make a more vigorous growth than cowpeas or soybeans and usually crowd out the legumes. In the humid regions such mixtures are more successfully grown, but the difficulty of harvesting the mixed crop prevents its extensive use. The growing of any mixture of this kind should be attempted only in localities where both the sorghum and legume are well adapted to climatic and soil conditions.

## UTILIZATION OF SORGHUM GROWTH FOR FORAGE

Sorghums grown for forage may be utilized as fodder, stover (fodder from which heads have been removed), silage, or hay, or they may be grown as a soiling crop (cut and fed green) or for pasture. Also the heads may be fed as such, or they may be threshed and the grain used as feed in much the same way as sorghums grown primarily for grain. The utilization of the grain sorghums is discussed in Farmers' Bulletin 1764.

### FODDER

A large percentage of forage sorghums are cut and fed in bundles as fodder or bundle feed. That is, the whole plant, including the grain, is fed without removing the heads, or threshing. Such fodder, if fully matured and properly cured, with a little protein supplement, will maintain livestock in good condition throughout the winter

with little or no grain supplement. If, however, for any reason the bundles contain but little grain, some grain may well be added to the ration. Sorghum fodder, as chemical analyses show, is nearly equal to corn fodder in food value. It is much more palatable and hence can be fed with less waste.

The average composition of fodder made from corn, kafir, and sorgo is shown in table 1.

TABLE 1.—*Average composition of corn, kafir, and sorgo forage*[1]

| Crop | Total dry matter | Total digestible nutrients | Protein | Fat | Fiber | Nitrogen-free extract | Mineral matter | Analyses |
|---|---|---|---|---|---|---|---|---|
| Fodder, dry: | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | *Percent* | *Number* |
| Corn | 91.1 | 59.4 | 7.8 | 2.2 | 27.1 | 47.6 | 6.4 | 59 |
| Kafir | 91.1 | 54.1 | 8.9 | 2.8 | 26.8 | 43.2 | 9.4 | 21 |
| Sorgo | 89.2 | 52.7 | 6.4 | 2.5 | 25.8 | 47.3 | 7.2 | 47 |
| Silage: | | | | | | | | |
| Corn, dent, well-matured | 28.3 | 18.7 | 2.3 | .9 | 6.9 | 16.5 | 1.7 | 248 |
| Sorghum, grain varieties | 31.3 | 17.8 | 2.1 | .9 | 7.9 | 18.1 | 2.3 | 19 |
| Sorgo | 25.1 | 15.1 | 1.5 | .8 | 7.0 | 14.2 | 1.6 | 94 |

[1] Compiled from Morrison's Feeds and Feeding, a Handbook for the Student and Stockman, ed. 20.

It will be noted that sorgo fodder contains somewhat less protein than either corn fodder or kafir fodder, but in other respects the composition of the three is about the same. There is, however, a difference in digestibility, as shown by the same authority. Thus, for the dry matter of the fodder the percentage of digestibility is for corn 66, for kafir 59, and for sorgo 58. Corresponding figures for the dry matter of silage are for corn 66, for kafir 55 and for sorgo 57.

In determining the proper amount to feed and the proper kind and quantity of supplements, if any, to use, consideration should be given to the moisture content of the fodder and the quantity of seed in the bundles. Sorgo plants consist of about 80 to 85 percent of water before maturity and of about 70 percent of water when ready to harvest. An average bundle of field-cured sorgo after 2 months in the shock, if from a good crop, will weigh from 12 to 16 pounds and will contain from 30 to 40 percent of water and from 10 to 20 percent of seed. A bundle will therefore contain approximately 9 pounds of dry matter, about 1½ pounds of which will be seed. The dry matter will consist approximately of 25 percent of heads (18 percent of seed), 15 percent of leaves, and 60 percent of stalks. If not too coarse and dry, the stalks will be largely consumed by livestock and may be considered as having palatability and feeding value equal to those of the leaves, if not greater.

If the crop is from an early maturing variety, harvested early and thoroughly dried in the field, the moisture content and the quantity of dry matter per bundle will be somewhat less. Also, if the crop is severely injured by drought late in the season, so that heads are not completely formed or well filled, the quantity of seed will be less. The dry matter in a crop that fails to head consists of about equal weights of stalk and leaves.

A bundle of grain sorghum fully matured and field-cured, harvested as fodder, will weigh 10 to 12 pounds and will contain from 20 to 40 percent of heads and from 15 to 30 percent of grain. A

bundle will therefore contain about 8 pounds of dry matter, about 2 pounds of which will be grain. In other words, the proportion of grain and the total amount of grain per bundle is somewhat larger than in sorgo bundles. The palatability of the stalks and leaves of the grain sorghums, except hegari, is lower than that of sorgos. The palatability of the stover differs with the varieties. Because of this, milo, feterita, shallu, and kaoliang are seldom harvested and fed in the bundle. On the other hand, hegari and kafir are used extensively as bundle feed; and though the stalks and leaves of kafir are less palatable than those of the sorgos, the difference is largely or entirely offset by the greater quantity and the greater palatability of the grain they usually contain. The variation in quantity and nutrient value of the feed in a bundle of sorghum is so great that no general rules as to the quantity to feed or the supplements to be used can be given. The above information, however, should be useful in determining a satisfactory ration.

Shredded sorghum fodder, mixed with corn chop, bran, cottonseed meal, or other concentrates, has given good results with dairy cows and, during the heavy-feeding periods, with beef cattle. Shredding decreases the waste in feeding, but unless the shredding can be done with little expense the practice is not often profitable.

## STOVER

Grain sorghums often, and the sorgos occasionally, are fed as stover; i. e., the heads are removed (fig. 24) and threshed, and the remainder is used as rough feed. Only those varieties of grain sorghums that have juicy stalks, such as hegari and some of the kafirs, are satisfactory for this purpose. Stover from milo, feterita, durra, and similar varieties is so dry and unpalatable that the feeding value is not sufficient in general to pay for the extra labor involved. Sorgos are sometimes grown for seed to be used by the grower or sold on the market. In such cases the stover is often a valuable byproduct.

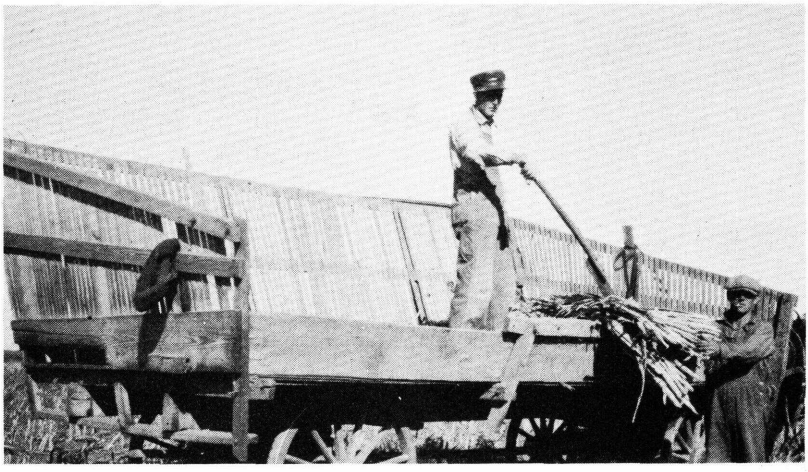


FIGURE 24.—Cutting heads from sorghum bundles with a so-called cheese knife.

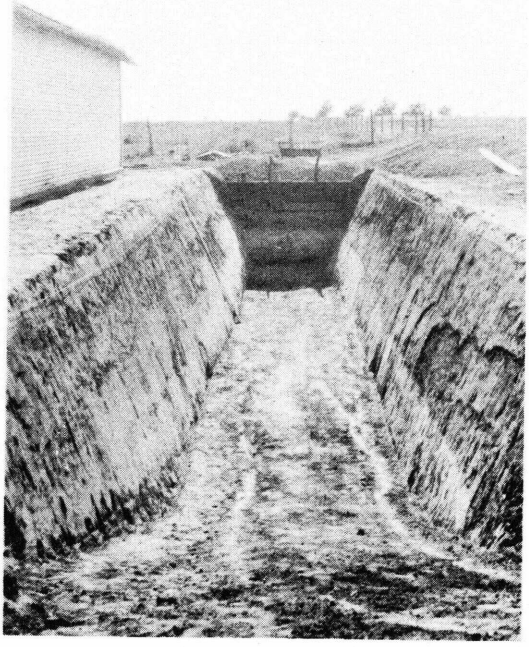


FIGURE 25.—A trench silo in western Texas.

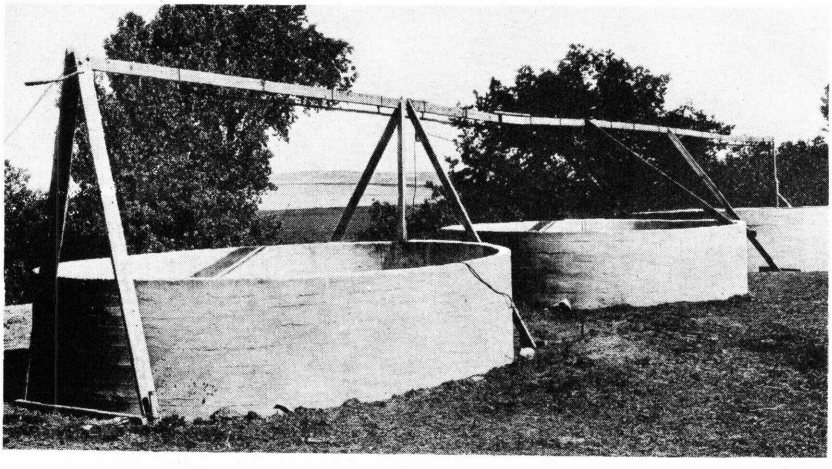


FIGURE 26.—Pit silos in western Kansas.

## SILAGE

The feeding value of an acre of sorghum is about 50 percent higher when fed in the form of silage than when fed as fodder, as is shown by gains made in feeding experiments. Despite this difference only a small proportion of the sorghum crop is put into the silo at the present time, but such usage is expanding rapidly. Trench and pit silos are shown in figures 25 and 26. The necessity for allowing the crop to become ripe before it is cut for silage often has not been realized. Silage made from green immature sorghum is likely to be sour and will not keep well, but if the sorghum is not cut until the seeds are hard the silage is even less acid than corn silage and keeps fully as well. Acre for acre, sorghum silage is superior

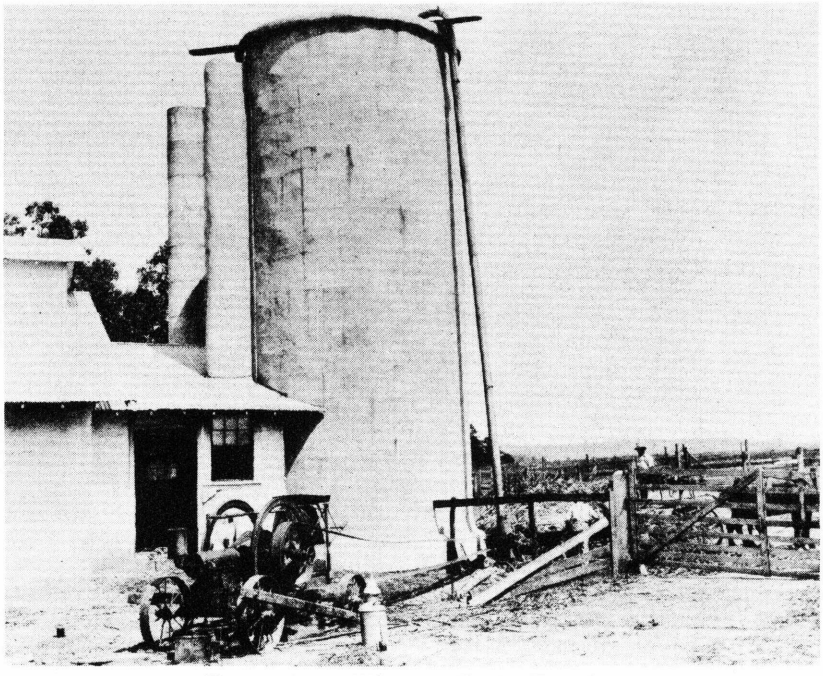


FIGURE 27.—Filling a silo in Georgia.

to corn silage in many sections, as figure 2 illustrates. Filling a silo is illustrated in figure 27, and the operation of a field silage cutter is shown in figure 28. Sorghum that fails to produce seed because of drought also makes satisfactory silage.

Experiments indicate that 30 to 50 percent, and sometimes more, of the sorgo and kafir seeds in silage pass through cattle whole. Results from the Oklahoma station indicate, however, that sorghum grain, whether kafir or sorgo, is utilized more completely when fed as silage than when fed unground in the head, threshed, or soaked. Much of the sorghum seed voided in manure may be utilized by allowing hogs or chickens to follow the cattle. Waste of sorghum seeds in silage can be largely avoided, and somewhat greater gains in feeding cattle may be obtained if the heads are cut off before the

FIGURE 28.—A field silage cutter harvesting hegari in Arizona.

stalks are siloed and the heads ground, or threshed and ground, before being fed along with the silage. This practice, however, involves so much additional labor and expense for topping, curing, threshing, grinding, and feeding that it is rarely considered justified.

Care should be used in planning the size of the silo, so that at least 2 inches of the silage will be fed to the stock each day after the silo is opened. If the silo is so large that less than this quantity is required, the silage will spoil on top.

## HAY

Sorghum hay may be utilized on the farm in the same way as any other hay crop. In general, the sorgos make better hay than the grain sorghums, though the latter are sometimes used for that purpose. Sorghum sown thickly for hay is more leafy than that grown in cultivated rows for fodder. Sorghum hay is often rather coarse, especially if planted too thin, and the stalks are likely to dry slowly and consequently contain too much moisture to permit baling. For these reasons sorghum hay is not generally suitable for marketing except locally.

## SOILING

If sorghum is grown for soiling (cutting and feeding green) several successive seedings should be made or several varieties of different degrees of maturity should be used, in order to extend the soiling season over a considerable period. A second growth starts promptly from the stubble, especially when the plants have been cut before maturity. The yield of soilage from sorghums is larger than that from almost any other crop. Yields of 12 to 15 tons per acre may be expected on fairly fertile soils (fig. 2). The crop can be grown for soiling either in cultivated rows or in close drills. Harvesting is a comparatively simple matter, the drilled sorghum being handled with a mower and rake and that in rows with a row binder or corn knife.

In using sorghums for soiling, special care must be observed to avoid bloating and prussic-acid poisoning. The sorghum can be cut from the time it is 2 to 3 feet high until it ripens, but earlier cuttings or small second-growth stalks are likely to contain dangerous quantities of prussic acid. Unless feed is badly needed, therefore, it is best to delay cutting until the plants have headed. In any event the precautions mentioned on page 38 should be observed.

### PASTURE

Sorghum has been recommended as a summer pasture for livestock of all kinds, but there is more or less conflict of opinion regarding its value for this purpose. The general result of well-planned experiments is to discourage its use as pasture both for hogs and cattle. Most of the successes with sorghum as pasture have resulted from letting milk cows graze on a nearly mature crop.

The principal objection is the danger of prussic-acid poisoning. There seems little danger to hogs and horses, but cattle, sheep, and goats are particularly susceptible. Farmers sometimes test the sorghum for poison by turning some animal of little value into the field first. If the poison is present in dangerous proportions the fact may become apparent in a few minutes. The fact that cattle are not equally susceptible to sorghum poisoning should be kept in mind in making such a test.

## SORGO SEED AS A GRAIN FEED

The seed of grain sorghums is valuable for all classes of livestock and poultry, being worth, when ground, nearly 95 percent as much as corn, measured by livestock gains. Sorgo seed, except that of white-seeded varieties such as Atlas, is less valuable because nearly all varieties contain an appreciable amount of a bitter principle resembling tannin. This bitter principle is distinctly unpalatable and has an astringent effect on the digestive processes, evidently thereby lowering the feeding value of the grain. Some evidence suggests that the bitter taste is at least partly dissipated when the grain is ground.

Whole sorgo seed has been found to be 67 percent and ground sorgo seed 77 percent as efficient as yellow corn in producing gains in feeding tests with hogs at the Kansas Agricultural Experiment Station. At the same station ground sorgo seed was substituted for corn chop in a ration for dairy cows without appreciable change in body weight, milk production, or butterfat production.

## PRUSSIC-ACID POISONING

A serious disadvantage in the use of sorghum as a pasture or soiling crop is the danger of cyanide or prussic-acid poisoning. Almost every farmer who has grown sorghum as a farm crop knows that it is dangerous to allow cattle to eat even a small quantity of sorghum before it has matured. The wild animals of Africa are said to avoid sorghum instinctively while it is young, refusing to eat it until it has ripened. However that may be, domestic animals in the United States show no such intuition, and a considerable loss of cattle occurs each year from sorghum poisoning.

The following points have been fairly well established:

(1) The prussic-acid content of sorghum decreases as the plant approaches maturity. Small plants (including those retarded by drought), early second growth, and young branches and suckers are high in prussic acid. Mature plants with ripe seeds are seldom dangerous, especially if the growth has been normal and few young suckers or branches are present. Most of the prussic acid is found in the leaves, and particularly in the younger leaves.

(2) Well-cured sorghum fodder has lost much of the prussic acid and ordinarily is safe to feed to animals. Partly cured sorghum may be dangerous.

(3) Sorghum silage can be fed with safety.

(4) Loss usually comes when hungry cattle stray into a field of sorghum. Pasturing of sorghum should never be attempted without first testing the field with an animal of little value. Even if the sorghum appears safe to pasture after such a test, the herd should not be turned in the field with empty stomachs. A light feed of grain given prior to turning the animals on the sorghum will do much to prevent injury.

(5) Less trouble is experienced in the Southern States than in those farther north.

The following remedy for cyanide poisoning, when it can be administered immediately after symptoms of poisoning appear, has been recommended by the Bureau of Animal Industry in Leaflet 88, Poisoning of Livestock by Plants That Produce Hydrocyanic Acid.

The injection of methylene blue, sodium nitrite, or sodium thiosulfate, preferably intravenously, has proved to be a practicable and valuable procedure. Especially promising is the injection of a combination of sodium nitrite and sodium thiosulfate. For cattle, 2 to 3 grams of sodium nitrite in water, followed by 4 to 6 grams of sodium thiosulfate in water, has protected against two minimal lethal doses. For sheep, up to 1 gram of sodium nitrite and 2 to 3 grams of sodium thiosulfate are recommended. This treatment may be supplemented by other measures, such as injections of atropine, the inhalation of ammonia, injections of glucose, or symptomatic treatment. Since the use of these drugs is attended with some danger to an animal, a trained veterinarian should conduct or supervise the treatment.

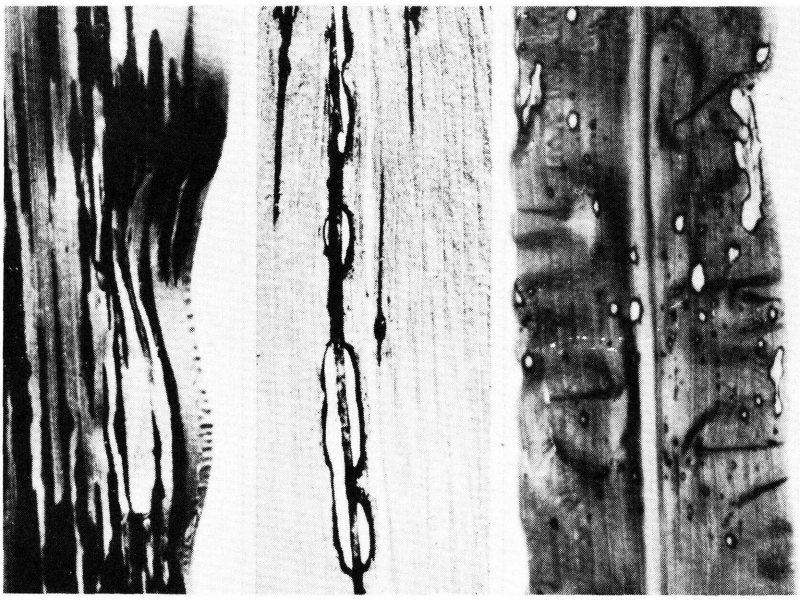
## DISEASES OF SORGHUMS

### RED SPOT

The red spot, formerly known also as sorghum blight (fig. 29), is perhaps the most troublesome of all sorghum diseases from a forage standpoint. It affects both the stem and leaves of the plant, manifesting itself in red or purple spots nearly circular or elongated into streaks and stripes. When these discolored areas become very numerous the leaves cease to function, and the growth of the plant stops. The so-called red spot is not a simple disease, because at least three species each of bacteria and fungi are known to cause different types of spotting. These bacterial organisms are *Bacterium andropogoni* E. F. Smith, *Bact. holci* Kendrick, and *Bact. holcicola* Elliott, and

the fungi are *Helminthosporium turcicum* Pass., *Colletotrichum lineola* Cda., and *Ascochyta sorghina* Sacc. Red or purple spots also are produced by insect and mechanical injuries and by hereditary factors.

Red spot is most destructive in warm, humid climates like that of the Gulf coast. It is always to be found on the Great Plains, but does little damage except in wet seasons. Some varieties are more susceptible than others. Sudan grass is of little value in Florida and other parts of the Gulf coast because of its susceptibility to this disease.



*A* *B* *C*

FIGURE 29.—Bacterial diseases on leaves of sorghum; *A*, Bacterial stripe; *B*, Bacterial streak; and *C*, Bacterial spot.

No remedy or preventive of red spot has yet been found other than the growing of resistant varieties. Leoti is the only variety of sorgo now grown commercially that is particularly resistant to the red-spot diseases caused by bacteria, and even this variety is not known to be resistant to the spotting caused by all fungi. In localities where red spot is especially destructive, as along the Gulf coast, "Japanese cane" (a sugarcane) or Napier grass instead of sorghum should be grown.

## KERNEL SMUT

The kernel smuts of sorghum may reduce seed production seriously with probably much less effect on forage yields. All sorgos and kafirs are particularly susceptible. In the kernel smut the individual grains or kernels in the head are attacked and changed into a mass of dark-colored spores (fig. 30). The head itself retains its

FIGURE 30.—Smutted and sound (center) heads of kafir.

FIGURE 31.—Head smut of kafir.

shape, and these spore masses look somewhat like elongated seeds. Two distinct species of smut occur, viz, covered kernel smut (*Sphacelotheca sorghi* (Lk.) Clint.) and loose kernel smut (*S. cruenta* (Kuehn) Potter). Several distinct physiological races of both smuts that attack different varieties have been isolated in this country. Kernel smut can be controlled by seed treatment. Dust fungicides, such as copper carbonate and organic mercury compounds, usually are effective. The formaldehyde treatment also has been successful. The treatments are the same as those used to control stinking smut of wheat.

### HEAD SMUT

The disease known as head smut is much less common than the kernel smut. The whole head when it emerges from the upper leaf is a mass of dark-colored spores mingled with the fibrous remnants of the host tissue and enclosed within a grayish membrane (fig. 31). This membrane soon ruptures and permits the escape of the spores

Head smut cannot be controlled by seed treatment because the disease is carried over in the soil as well as in the seed. The only safe plan is to avoid the use of seed from localities where it is known to occur and to cut out and burn all plants affected with it before the smut masses break open.

## INSECT ENEMIES [4]

### GRASSHOPPERS

Grasshoppers are somewhat troublesome to sorghums. The chief damage is to the ripening seeds. Grasshoppers eat sorghum leaves very reluctantly, but they seem to prefer leaves of milo and hegari to those of most other sorghums. They may be controlled with sprays or dusts containing aldrin, chlordane, heptachlor, or toxaphene.

### CHINCH BUGS

Most of the better varieties of forage sorghums are not injured very extensively by chinch bugs unless the infestation occurs when the plants are small. Among the sorgos, Honey, Leoti Red, Black Amber, and Red Amber are the most susceptible. Hegari is more susceptible than the kafirs and other grain sorghums commonly grown for forage. Milos are more susceptible to chinch-bug injury than any other of the sorghums.

Where the chinch bugs have not developed wings they may be kept from a field to a large extent by the use of barriers. Several kinds of barriers are effective, including dieldrin, DDT, dinitrocresol, and creosote. South of central Kansas, where the chinch bugs develop wings by the time small grains are harvested, they migrate to the sorghum fields by flight, and barriers are ineffective. In these areas and when border rows of sorghums are invaded before barriers are constructed, chinch bugs may be controlled with insecticides. Apply sprays or dusts containing toxaphene, dieldrin, or nicotine sulfate to the base of the plants where the bugs congregate.

Chinch-bug injury can often be reduced by early planting, by planting sorghums as far away as possible from fields of small grain, and

[4] Prepared by the Entomology Research Branch. For additional information on insect enemies of sorghums see Farmers' Bulletin 2064, Grasshoppers—A New Look at an Ancient Enemy, Leaflet 364, Chinch Bugs—How To Control Them, and Farmers' Bulletin 1566, The Sorghum Midge, With Suggestions for Control.

by avoiding susceptible varieties. The larger the plants when the chinch bugs arrive, the better they are able to survive the attack. The bugs commonly pass the winter at the base of bunches of grass and in the piles of trash usually found along fences and hedgerows and to some extent in sorghum stubble. Burning the grass and trash in November or December destroys a large percentage of the chinch bugs and may do much to prevent trouble with them the following summer if there is no other grass nearby where the bugs are hibernating. Indiscriminate burning is not recommended because of injury to the grass and to various forms of wildlife.

### SORGHUM MIDGE

The sorghum midge is abundant in the Southern States from central Texas eastward. In that region it often has prevented the production of sorghum seed to such an extent that the growing of grain sorghum is unprofitable.

The sorghum midge is a small fly with a red body. It lays its eggs within the hulls or glumes of the sorghum flower during blossoming time. The egg produces a small white larva, or grub, which takes its position alongside the developing ovary and absorbs the juices, thus preventing the development of the seed. This larva soon attains its growth and changes into a pupa, from which the adult fly, or midge, emerges in a few days and starts a new generation by depositing eggs on other sorghum heads. Under favorable conditions of temperature and moisture this whole process requires only 14 days, the average time being from 14 to 20 days. The adults do not feed on the developing seed; only the larva does injury in this way.

The midge appears first in the spring on Johnsongrass and breeds there sufficiently to infest cultivated sorghums in considerable numbers as soon as the crops come into head. All sorghums are subject to its attacks, and it has been found also on foxtail and certain other wild grasses. Absence of the cultivated sorghums from any community throughout an entire year is therefore not disastrous to the midge. It lives over winter in the larval state in heads of the sorghums and Johnsongrass that remain as trash on the fields or along fence rows. Parasites become numerous usually late in the season and destroy large numbers of the midge, but too late to prevent the greater part of their injury to the sorghums. Damage to sorghums from midge appears to be much less than in former years, possibly because of an increase in parasites of the midge.

One way of combating the sorghum midge is by planting very early in the season, so that the sorghums will come into bloom at a time when the midge is not plentiful. Early seeding and careful harvesting of sorghum fields, together with the destruction of all the Johnsongrass in adjoining areas, will lessen the evil but may not completely overcome it. The damage from a forage standpoint is slight, as the sorghum makes good fodder even when it has failed to form seed, but the lack of homegrown seed of the better forage varieties no doubt decreases the acreage of this crop in the midge-infested States.

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